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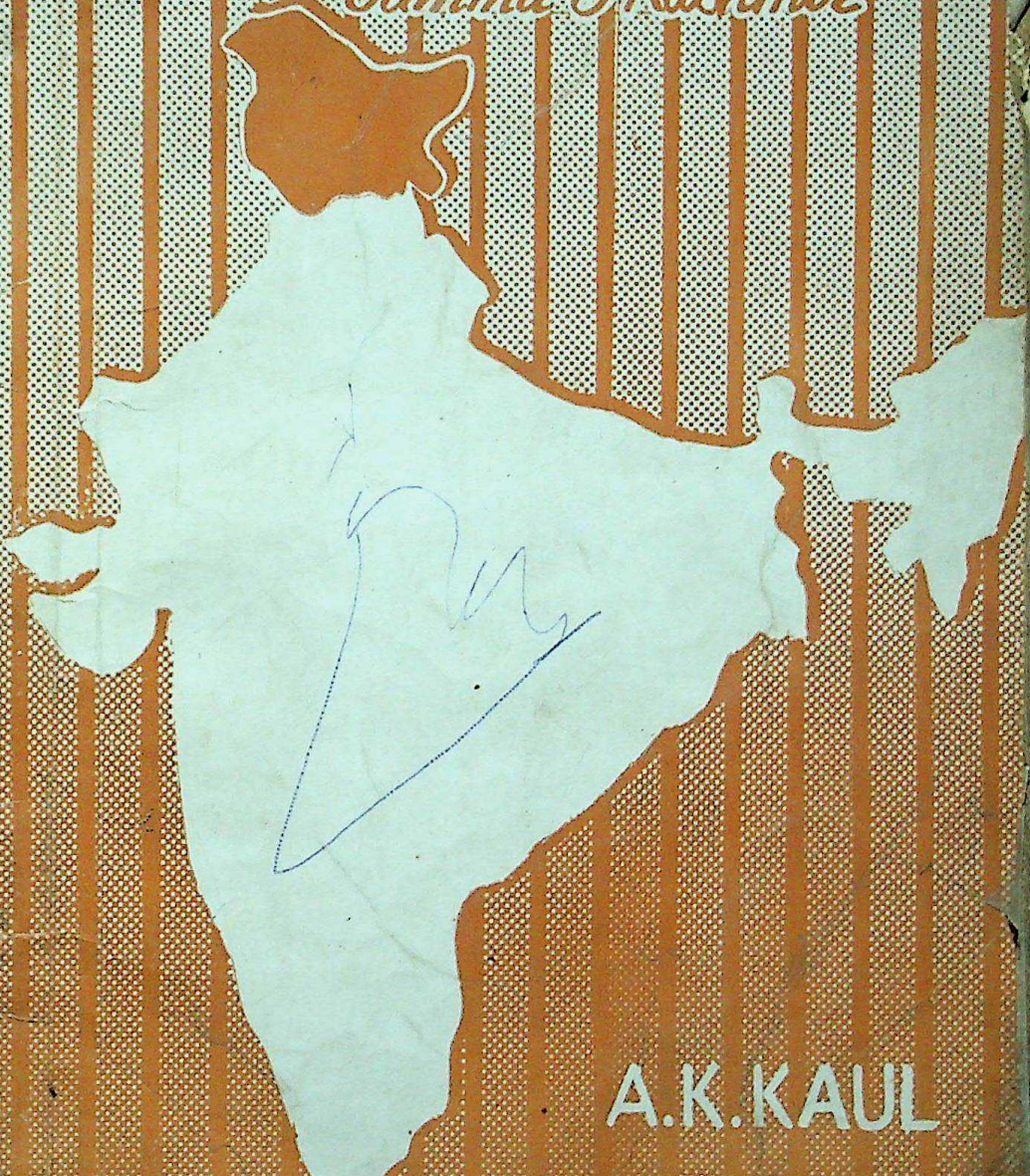
Jammu & Kashmir



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A Geography of J&K and Other Essays

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PREFACE

This concise book on the geography of Jammu and Kashmir has been written to serve the needs of students of Colleges of Education, Degree Colleges and Higher Secondary Institutions. This will also prove helpful to candidates appearing for competitive tests and interviews. It will aid in service teachers in their day to day class teaching.

In addition to geography of J & K the book, in part II, contains some geographical essays of current and common interest.

Latest data, as far as possible, has been incorporated in the text. Among other sources, the data has been drawn from (a) Census of India, 1981-Series 8 (J & K), Part I, Supplement ; (b) Digest of Statistics, J & K Govt., 1981-82, Directorate of Economics and Statistics ; (c) Industrial Development in J&K at a glance, August 1982, Directorate of Industries and Commerce, and, (d) O.N.G.C. Data-1982.

I am grateful to my friend and colleague, Prof. A.K. Abrol, Head, Department of Geography, G.M. Science College, Jammu for his constant inspiration and guidance. I am thankful to my daughters Aruna and Anju for preparing the index of this book.

Suggestions for improvement of this book shall be welcomed.

A.K. KAUL

August 17, 1985

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PART—I

GEOGRAPHY OF J&K

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1

INTRODUCTION

India consists of twenty two states and nine union territories. Jammu & Kashmir is one of the states of the Indian Union. It is situated in the north west of the country. Leh, the headquarter of Ladakh district, lies at a distance of 1270 km. to the north of Delhi – the union capital.

Location. J & K is located between latitudes 32° 17′ north and 37° 6′ north and longitudes 73° 26′ east and 80° 30′ east.

Position. It is the northernmost state of India. It is also a border state. Here the national boundaries touch the neighbouring countries of Tibet in the east, China and Afghanistan in the north and Pakistan in the west. This locational aspect of J & K accounts for its geo-political significance.

To its south lie Panjab and Himachal Pradesh, the other two states of India. With its borders sealed on the east, the north and the west, the state of J & K is accessible only from the south. It is through its south that the state has road, railway and air links with rest of the country. Such a position gives the state an appearance of a bottle lying on its side with its mouth facing south. The state has, therefore, a terminal and not an advantageous position.

Area. Jammu & Kashmir state was founded by Maharaja Gulab Singh, in 1846, after integrating four heterogeneous regions of Jammu, Ladakh, Kashmir and Gilgit. The total area of this state on August 15, 1947 was 2,22,236 sq. km. The political events in the sub-continent that followed *partition* disfigured the map of our state. Pakistani troops invaded the state in Oct. 1947. About one-third of the total area of J & K is under illegal occupation of Pakistan. This was followed by Chinese Aggression of 1962 when a large chunk of Indian territory in

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Ladakh was illegally occupied by China. The present distribution of the area of J & K is given below :

J & K—Distribution of Area

(i)	Total Area of J & K state as on Aug. 15, 1947.	2,22,236 sq. km.
(ii)	Area under illegal occupation of Pakistan.	78,932 sq. km.
(iii)	Area illegally handed over to China by Pakistan.	5,180 sq. km.
(iv)	Area under illegal occupation of China.	37,555 sq. km.

[*Source* :—Census of India, 1971—Series 8, Part II A, General Information Tables—Page 25]

The two provinces of J & K state are Kashmir and Jammu. Ladakh region forms part of Kashmir Province. The population of the state according to 1981 census was 59,54,010. A study of area and population of the three units of J & K reveals interesting comparisons. Ladakh with largest area has least population and Kashmir with least area has the highest population. Jammu province stands at number two in area as well as in population.

J & K—Area & Population—1981

	Province/Region	Area	Population
(i)	Jammu	19%	45·2%
(ii)	Kashmir	11·5%	52·6%
(iii)	Ladakh	69·5%	2·2%

———

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2

PHYSICAL FEATURES

Jammu & Kashmir on the south is bounded by the Great Indian Plain, with an average altitude of 300 m. While on its north east stand the lofty plateaus of Tibet which have a mean elevation of 4,000 m. or more. Between these two extremes of terrain, the area is occupied by a series of mountain ranges, of varying elevation, running in south east—north west direction, almost parallel to one another. These are the Siwaliks, the Middle Mountains, the Pir Panjal, the Great Himalayas, the Zanskar, the Ladakh and the Karakoram. A number of rivers like the Ravi, the Tawi, the Chenab, the Jhelum, the Kishenganga, the Suru, the Zanskar, the Indus and the Shyok have carved out their valleys through or between these mountain ranges. All these rivers are part of the Indus Drainage System.

The three main regions of the state are the sub-Himalayan Jammu, the Himalayan Kashmir and the trans-Himalayan Ladakh. If these regions are likened to three steps of a terrace, the lower step is formed by Jammu, the middle step by Kashmir and the upper step by Ladakh. The state can be divided into the following five physiographic divisions.

(i) The Outer Plains.
(ii) The Outer Hills or the Siwaliks.
(iii) The Middle Mountains.
(iv) The Valley of Kashmir.
(v) The Ladakh Region.

Each region shall be taken up for detailed discussion :

(i) The Outer Plains

In the south of the state, all along its border, is a narrow strip of an alluvial plain, with a width ranging between five to twenty-five kilometres. This in reality is an extension of the Great Indian Plain. The

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Outer Plains stretch from the Ravi to the Chenab for a distance of 110 km. The elevation of this tract is from 330 to 360 m. Locally this plain is called *Anderwah* and *Bajwat*.

The Outer Plains lie almost parallel to the mountains of Jammu. The streams, ravines and gullies issuing from these mountains run across this plain. The plain is badly dissected by a series of deep and shallow ravines. Some of these lie at a depth of 30 m. below the general level of the ground. These have a width of 35 m. to 1·5 km. For most of the year these ravines are dry. The bed is filled with sand, gravel and boulders with clumps of wild growing tall grass, the *khar*. During the rainy season the ravines, locally called *khads*, are transformed into gushing torrents, which move huge amounts of sand, red mud and boulders. The vehicular traffic on Jammu—Pathankote National Highway comes to standstill on such occasions. The number of ravines can easily be visualised from the fact that Kathua—Jammu Railway Line has to cross two hundred, major and minor bridges.

In addition to rivers Ravi and Chenab, the other streams flowing through this region are the Ujh, the Basanter, the Tawi and the Manawar Tawi. Sections of this region afford rich agricultural land but raising of crops throughout the year is possible only through irrigation. The common methods are canals, wells and tube-wells. Number of canals have been drawn from the rivers and streams listed above.

The productive croplands are in Kathua, Hiranagar, Bishnah, R.S. Pora, Domana and Akhnur. Parts of Jammu city like Talab Tilo, Gandhinagar and Satwari belong to the Outer Plains.

(ii) The Outer Hills

To the north of outer plains stands the outermost range of the Himalayas—the Siwaliks. These are also designated as the Outer Hills or the Himalayan Foothills. In J & K these hills stretch from the Ravi to the Jhelum for a distance of more than two hundred kilometres. They attain a maximum width of 20 to 50 km. in this state. The height of these hills is between 610 to 1220m. The main ridgas run in the southeast —northwest direction but other ridges move transverse to this general direction.

The Siwalik Hills were formed long after the rise of the main Himalayas. The rivers draining these Himalayan heights brought huge

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quantities of debris with them and piled it up in the Siwalik zone. It consisted mainly of clay, sand and boulders of different sizes. This fluvial material was later on subjected to folding which resulted in the formation of a series of low parallel ridges, the Siwalik hills. Between these anticlinal hills lie sloping plateaus.

The hills slope gently towards the plain. These slopes are covered by boulders and clay. On the inner side these hills end abruptly and the rocks are mostly grey sandstones. The outer slopes are covered with evergreen bushes and bear an open scrub forest.

The Siwalik hills like the Outer Plains are also badly dissected by ravines and stream courses. On this account they present the appearance of isolated hills and broken hill ranges. From Basohli in the east to Poonch in the west, the Siwalik hills present a broken and rugged terrain. This region enjoyed comparative peace during that period of Indian history when northern India was stormed by waves of invading hordes. The Siwaliks offered a haven of refuge for those who wanted to escape repeated disorder and violence in the Indian plains.

The lower slopes of these hills, from Ravi to Chenab and beyond upto Bhimber, at an altitude of 300 m. to 700 m. constitute what is known as *Kandi*. This region is characterised by thirsty soils, a very low water table and scarcity of water. Every shower of rain deprives the soil of its clay content. More and more pebble beds get exposed. Erosion is rampant. In the vegetation cover xerophytes predominate. Agriculture is entirely dependent on rainfall. For their sustenance in this harsh environment people have to work very hard.

Jasrota, Samba, Jammu and Akhnoor are the Siwalik towns. They are situated at a point where the streams, Ujh, Basanter, Tawi and Chenab, in each case, leave the highlands and debouch into the Outer Plains.

To the north of the Siwalik hills lie series of wide longitudinal valleys, called the *doons*. These comparatively level stretches provide sufficient arable land. The important *doons* are Basohli, Ramkote, Dansal, Udhampur and Sunderbani. The Udhampur—Dhar Road is constructed through the doon region.

In the Siwalik range, to the east of Jammu city are situated the lakes Mansar and Saruinsar at an elevation of 600 m. These lakes stand fifteen kilometres apart.

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Jammu city occupies the south facing slopes of the Siwalik hills on either banks of the Tawi. It extends into the Outer Plains which lie on the west and the south. It has an altitude of 366 m.

(iii) The Middle Mountains

The next physiographic division of Jammu province is the mountainous country that lies on the north of the Siwalik hills and the *doons*. These mountains have an average elevation of 1820 m. to 2240 m. Locally the region is called *Pahar*.

The Middle Mountain range, in our state, begins from the right bank of the Ravi and passes through Loango, Basantgarh, Dudu, Seoj, Marothi, Sudh Mahadev, Kud, Batote, Tangar, Gool, Arnas, Paoni, Barakh, Dhaleri, Rajauri and Poonch and beyond to Muzzafarabad. In the east the range has a width of sixty kilometres and extends as far as Bhaderwah and Kishtwar. In the west, close to Rajauri, it decreases to 10 km. and beyond Poonch, the width of these mountains again increases.

From the main ridge number of branch ridges radiate in all directions, both on the northern as well as on the southern flanks. At Tangar, a branch ridge runs due south west. It is the Trikuta Mountain. The three conspicuous peaks of this mountain are in view from Jammu city. In this limestone mountain is situated the sacred cave of *Vaishno Devi*, which draws lakhs of devotees from all over India.

The intervening spaces between the diverging spurs and ridges are occupied by valleys and plateaus. Slopes predominate and these have been terraced for cultivation and for dwellings. The streams like Ujh, Basanter, Tawi and Manawar Tawi have their sources in the Middle Mountains. The source of the Tawi is at Seoj. It is a medow, surrounded by high mountains. One of the peaks in the vicinity rises to an elevation of 4340 m. Let us call it Kailash peak. This happens to be the highest spot in the Middle Mountains. On the mountain rim lies the Kaplash Kund. A nearby pass leads into Bhaderwah.

For some distance the Chenab separates the Middle Mountains from the Lesser Himalayas. It takes a sharp bend and cuts through the Middle Mountains at Salal.

The predominant rocks in the Middle Mountains are the red or purple coloured Miocene Murree sandstones and light yellow Eocene

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Nummulitic limestones. The important rock of the Trikuta Mountain is the Permian limestone. In the Nummulitic limestones of the Reasi area are found the deposits of iron ore, bauxite and coal. Gypsum depositsare found in Ramban—Batote—Assar area.

The slopes of this range are clothed with temperate monsoon forests. The important species found in the region are deodar, bluepine, silver fir and oak.

Bhaderwah is a lovely scenic spot in the region and so is Kishtwar. The hill stations of Kud and Batote provide welcome relief to the people of Jammu during hot summer. A tourist complex has come up at Patni Top. The national highway, at Patni Top, passes over the highest elevation of 1950 m. Not far away is the forest girlded meadow at Sanasar.

(iv) **The Kashmir Valley**

After sub-Himalayan Jammu, the next step of the terrace is the Himalayan Kashmir. The two main ranges of the high Himalaya that enclose this region are the Great Himalayas or the Himalayas in the north and the Lesser Himalayas or the Pir Panjal in the south. The alignment of these two ranges in this region is quite interesting. The convex bulge of the Pir Panjal and the concave surface of the Himalayas have given rise to an oval basin of Kashmir. The long diagonal of this oval is parallel to the general run of the Himalayas. The rocky basin is filled with a thick deposit of alluvium. This alluvium has even blanketed the lower slopes of the bounding ranges.

(*a*) *Mountain Ring*

The enclosing mountain ranges on the north and the east branch out from the Main Himalayan Axis. The Pir Panjal encloses the Valley on the south and the west. The average height of the Himalayan range is 4265 m , while that of Pir Panjal is only 4000 m.

The mountain ring round the Valley is not complete. There is a gap in the west. Here two branch ranges of Lesser Himalayas—the Pir Panjal and the Qazi Nag —run parallel to each other and form a gorge. It is through this gorge that the Vyeth (or the Jhelum) after collecting the entire drainage of the Valley leaves it on a downward journey to the plains.

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Into the main longitudinal Valley of Kashmir open a number of transverse valleys. Two such side vaileys in the east are the Sindh and the Lidder. Similarly we have the valleys of the Kahmil and the Lolab in the north-west. From the enclosing mountain ring project number of spurs into the main Valley which in most cases end in an isolated hill. Hills of Shankaracharya and Baba Shakurudin, Aha Teng and *Baal* at Anantnag are some examples of these isolated hills.

The outer slopes of the Pir Panjal are rather steep, while the Valley facing slopes fall gradually and in steps. Wadia calls such terrain as having writing-desk shape. On these steps are found the famous meadows of Khillanmarg and Kongawattan, Gulmarg and Yusmarg. Dr. Arthur Neve writing about these Valley facing slopes of the Pir Panjal remarks that the configuration of the ground is such that fifty Simlas might be built here on a comparatively level ground.

The Himalayas in their true grandeur are encountered in north-eastern Kashmir. Here the mountain mass assumes a width of 64 km. This constitutes the headwater region of the streams Lidder and Sindh. Here is the highest peak of Kashmir Himalayas, the Mt. Kolahoi (5420 m.). On the shoulders of this ridge is found a glacier of the same name. Kolahoi glacier is the largest in Kashmir region. Not far away is the sacred cave of Shri Amarnath Ji. It is visited by thousands of pilgrims in the months of July and August every year.

The entire mountain rim has experienced glaciation in the past, so here we have serrated ridges, pyramidal peaks, U-shaped valleys and moraines. The mountain rim is interspersed with tarns which are generally found above 3,500 m. Some famous tarns are Sheshnag and Gangabal in the Himalays and Kounsar Nag and Alpather in the Pir Panjal. Streams originate from the tarns, glaciers or springs found in these mountains. Every tributary stream of the Vyeth (the Jhelum) flowing down this mountain rim has been utilised, since ancient times, for purposes of irrigation. Canals drawn from these mountain streams are responsible for the agricultural prosperity of Kashmir Valley. These are also being utilised for the generation of hydro-electric power. The Lidder, The Sindh, the Vishau are the important mountain streams.

Access into the Valley or out of it has been possible because of the passes in the mountain rim. Even today motorable roads have been built across these passes. The Jammu—Srinagar National Highway

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passes through Jawahar Tunnel (2210 m.). The tunnel has been pierced through the Pir Panjal range below the Banihal Pass. The road to Leh crosses the Zoji La (alt. 3525 m.). Similarly, Razdiangin Pass leads into Gurez and Nestechun Pass into Karnah, both in the Kishenganga valley. The last three passes remain snow bound for half the year when vehicular traffic comes to a stand still. A road is under construction over Smithan Pass to connect Srinagar with Kishtiwar.

The Pir Panjal bears the brunt of the frontal attack of the south-west monsoon, hence its outer slopes are more rainier than the Valley facing slopes. Contrary to it the Valley facing slopes of the Himalayas receive more rainfall than the inner slopes. Ladakh region, in fact, lies in the rain shadow of the Himalayas. The effect of orography on rain-fall is well pronounced in the Himalayan flank where Sonamarg receives the highest rainfall (of 1800 mm. against 664 m. at Srinagar) in Kashmir region.

The slopes of the mountain ring, upto an altitude of 3300 m., bear a thick temperate vegetation cover. The main species are blue pine, deodar, Himalayan spruce, silver fir, ash, walnut, maple and poplar.

Kashmir basin carries an uninterrupted record of rock formations from the pre-cambrian to the Jurassic period. The predominant rocks are the light green basalts and bluish-grey Triassic limestones.

(*b*) *The Valley Floor*

The present floor of the Valley is the drained out and exposed bed of the prehistoric lake called the *Satisara*. Geologists call it as the Karewa lake. The Vyeth (the Jhelum) is the main drainage artery of the region. Soon after the drainage of the *Satisara*, the Vyeth and its tributaries dissected the lake bottom and carved out their channels through the soft sediment. Sections of this lake bottom stand as isolated blocks a rising to a height of about 135 m. above the river. These uplands of Kashmir are called Karewas. Locally they are known as *Wudars*. In the middle of the Valley the Karewas are flat topped but along the mountain ring they are sloping. The sloping Karewas have been irrigated by the canals drawn from the mountain streams. The flat topped Karewas for cultivation depend upon rainfall. The Karewas consist mostly of clay, silt and sand.

The Vyeth occupies the lowest furrow in the Valley floor, so that all tributary streams flowing down the mountain girdle have it for their

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destination. The Vyeth, therefore, is the master stream. It has an assymetrical position in the Valley floor for it lies closer to the Himalayan than the Pir Panjal flank. The river has shaped its flood plain through which it flows as a placid, meandering and mature stream In the Vyeth flood plain are a number of marshes and lakes. The marshes or wetlands as a rule lie on the wide left bank plain while the lakes are along the right bank. The lakes are the Dal, the Anchar and the Mansbal. The master stream debouches into the Wular lake on its south and flows out of it on the west. The river is navigable from Khanabal in the south to Khadinyar in the west. Beyond the latter the river enters the Vyeth gorge. In the past the Vyeth served as a main highway. Boats of different sizes and shapes carried goods and passengers up and down this waterway. All the major towns sprung up on its banks. Srinagar, the summer capital of the state, is situated on its either banks in the middle of the Valley. It lies at an altitude of 1585 m.

The Valley floor presents the largest stretch of lowland in the entire Himalayan region. From Verinag in the south to Kupwara in the north the Valley floor measures 150 km. Its width along the latitude of Srinagar is 40 km.

The deep alluvial soils with facilities of canal irrigation are highly productive. Rice is the chief *Kharif* crop. Commercial crops include temperature fruit, saffron and hops.

A discussion of Kashmir physiography is incomplete without the mention of two minor subdivisions—the Vyeth gorge and the Kishenganga Valley.

(c) *The Vyeth Gorge*

Some distance below Khadinyar the two branches of Lesser Himalayas—the Pir Panjal range and the Qazi Nag range run close and parallel to each other and give rise to Vyeth gorge. The Pir Panjal range forms the southern and the Qazi Nag range the northern wall of this gorge. The Vyeth which in the Valley was a sluggish and mature stream gets transformed, in this gorge, into a foaming mountain torrent. The decrease in elevation between Gantemulla to Uri, in a distance of 30 km. is 300 m. The mountain wall along the left bank has a steep slope and bears a forest of blue pine and deodar. The mountain slopes along the right bank fall gradually. These have a sunny aspect and are under plough. Most of the hamlets are located on this side. The region too has experienced glaciation. It is evident from the heaps of moraines

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that lie piled up at several localities. The fields and the river bed is strewn with erratics. The moraines mostly consist of the granites from Qazinag range. The area has also undergone rejuvenation. Several river terraces are identified. The motorable road is built over one such terrance along the left bank.

The Vyeth gorge is significant on two counts. It has a rich potential for hydro-electric power generation. Here are found large deposits of minerals like gypsum, graphite and ochre.

(d) The Kishenganga Valley

Kashmir region on the north and north west is bounded by the river Kishenganga. It is an important tributary of the Vyeth (the Jhelum) and joins it at Muzzafarabad. On the north facing slopes of the northern mountain range are situated Tilel, Gurez and Karnah. The Kishenganga flows some distance away and below these localities. The Razdiangin Pass leads into Gurez, wherefrom Tilel can be reached. The environment is cold, harsh and bleak. Karnah on the other hand has a sunny aspect and is warm. The Nestchun Pass leads to Karnah. Both the passes remain snow-bound and closed for about six months, in a year.

LADAKH REGION

(d) The Kishenganga Valley

The dominating features of the terrain of this trans-Himalayan region are towering mountain ranges, deep narrow river valleys, lofty windswept plateaus and high vast plains. High altitude and rugged topography are the chief characteristics. High altitude results in low temperature. As the region lies in the rain shadow of the Himalayas precipitation is meagre. The mountain slopes are bare and without any forest cover. Weathering of the rocks is quite rife in the region. Erosion due to running water is absent. The rock waste mostly lies *in situ*. Where the slopes are steep it gravitates down to collect as scree. Sand, gravel and broken rock cover large areas. The widespread rock waste, low temperature, scant precipitation, absence of vegetation and high winds have made Ladakh region a cold desert. Wherever water from mountain streams is available for irrigation, villages have sprung up on sand and gravel heaps or on alluvial fans. These villages, scattered and far off, with green fields and white washed, well-kept, houses present the sight of an oasis in this bleak desert landscape.

The main Himalaya running, between the peaks of Nun-kun (7135 m) and Nanga Parbhot (8127 m), bounds Ladakh region in the south

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Branching from it and later on running parallel to it is the Zanskar range. The Indus furrow is walled by the Zanskar range in the south and the Ladakh range in the north. Between the Ladakh range and the Karakoram range is situated the Shyok Valley. In the north-eastern corner of the region are the Lingtzi Tang or Aksaichin plains. In the south east and east are the high plateaus of Changthang. All the mountain ranges detailed above run parallel to one another. The air, due to great altitude, is rarefied, and one has to get acclamitized to it.

(*a*) *The Zanskar Range*. The average altitude of this mountain range is 5940 m. The space between the Zanskar range and the Great Himalayas is occupied by a series of ridges branching out from either of these ranges. In this area are two river valleys—the Zanskar and the Suru. The Zanskar lies in the east. Padam is the main village of the Zanskar valley. It is perched on a heap of moraines. The area is marked by severity of climate. It remains cut-off from rest of the World for seven to eight months in year, due to snowfall on the Pensi La Pass. Men and beast (particularly ponies) are confined to indoors for half the year. The growing season is too short and agriculture is possible with difficulty.

In the Suru Valley lies Kargil at an altitude of 2676 m. This area is marked by comparatively low altitude, sunny aspect and slightly more precipitation. In local dialect this area of Ladakh region from Dras to Nemmo is called *Sham*. Here two crops—one of grim and another of turnips can be raised within the growing season that extends from April to September. Soils are fertile but the major problem is the non-availability of water for irrigation. The National Highway crosses the Zanskar range through two passes—Namki La (3718 m.) and Fatu La (4108 m).

(*b*) *The Indus Valley*. The Indus is the largest river of the Indian sub-continent. It enters the Ladakh region from south-east. It flows in a south-east—north-west direction for a distance of about 500 km. It occupies a narrow valley and flows slowly through it. On its right bank and close to it stands the mountain wall of Ladakh range—with an average altitude of 5790 m. The Zanskar range forms the left flank but it stands farther away from the river. The streams—Zanskar and Suru—after cutting through the Zanskar range join the Indus on the left bank. While the river Shyok is the important right bank tributary.

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On the right bank of the Indus and above it is situated Leh, the headquarter of this region, at an altitude of 3505 m. It occupies an alluvial fan which at its base is 8 km. long. It has a thickness of 300 m.

To the east of Leh, on either bank of the Indus, is an alluvial plain which extends to a distance of 30 km. The enclosing slopes consist of soft rocks. Here the snow fed streams, flowing down these slopes, have formed number of alluvial fans. This area makes up the most fertile and productive lowland of the Ladakh region. Number of village are there in this lowland. On the left bank of the Indus and overlooking this plain stands the famous monastry of Ladakh—*Hemis Gompa*. It symbolises the fertility and prosperity of this region. But for this alluvial lowland the entire Indus Valley is a broken and a barren country, where dry, bare, scree covered, slopes are a common sight. It receives the least rainfall of the region. From Nemmo to Changthang the area is locally called *stot*. Here only one crop, i.e. grim, can be raised during the growing season that lasts from May to September.

A motorable road, from Leh, crosses Khardung La (5600 m.), in the Ladakh range, to enter the Shyok Valley. Khardung La happens to be the highest spot in the world over which motor vehicles move.

(*c*) *The Karakoram.* A number of mountain chains, including the Himalayas, radiate from the Pamir Knot in various directions. The Himalayas are reinforced on the north by a mountain chain, known as the Karakoram. Its short length is compensated by very lofty peaks. K_2 or Mt. Godwin Austen, with an altitude of 8610 m., is the second highest peak in the world after Mt. Everest. The largest valley glaciers in the world, outside sub-polar region, are situated in the Karakoram. These are Siachen, Baltoro, Hispar, Rimo, Baifa and Batuna. Saichen glacier is 72 km. long.

Between the Ladakh range in the south and the Karakoram in the north lies the Valley of River Shyok. The Shyok originates from the eastern edge of the Rimo glacier. It flows in the beginning from north-west to southeast but later on takes a bend and flows in the opposite direction. It is joined at Disket by the river Nubra, which also begins from the eastern Karakoram glaciers. Soon after this confluence Shyok runs parallel to the Indus from which it is separated by the Ladakh range. It joins the latter near Skardu.

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(*d*) *Plateaus of Chargthang* The area situated in the east of Ladakh is called, in the local dielect, Changthang. The people inhabiting this area are called *Changpas* or *Champas*. In the eastern part of Ladakh the lofty ranges of the Zanskar and the Ladakh enclose intermontane plateaus. One of these is Rupshu. The average altitude of this plateau is 5000 m. These wind swept high plateaus are characterised by severity of climate. Water freezes at night even in the months of June or July. Very little and short grass grows near springs or water courses. The hardy *Changpas* roam thousands of square kilometres of this barren wilderness in search of fodder and water for their livestock—Yak, goats and sheep. Changpas are basically pastoral people.

In the Rupshu plateau are a number of salt water lakes like Tsomoriri, Tsokhyagyar and Rupshu. Edible salt is collected from these lakes. Close to Tsomoriri is situated Karzok (5167 m.) the highest agricultural settlement in the world. In Changthang area are found hot springs in Pugga Valley and at Chumathang.

(*e*) *High Plains of Aksaichin*. The northeast corner of Ladakh region consists of the vast and high plains of Lingtzi Tang or Aksaichin. The level plains are unfit for agriculture. Most of these plains are under illegal occupation of China, since the agression of 1962. To the south of this plain lies a salt water lake Pangong at an altitude of 4180 m. The lake lies on the border between India and China. On its west bank lies the border village of Chusul.

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3

WEATHER AND CLIMATE

Climate of a particular place is the net result of the combination of of several factors like latitude, altitude, terrain, distance from sea and prevailing winds. Let us know the broad outline of the climate of J & K in the light of these factors.

(*i*) **Latitude.** This state is located between the latitudes of 32°N and 36½°N. Latitudinally the area lies in the sub-tropics. But in reality, it is the Outer Plains and Outer Hills region of Jammu that have a sub-tropical climate. The other two regions-Kashmir and Ladakh experience a different type of climate, the modification being introduced by altitude.

(*ii*) **Altitude.** The altitude above sea level of the three regions of J & K increases as we proceed towards north. Increase in altitude results in decrease of temperature, Jummu (city), Srinagar and Leh are the representative stations of these three regions. Below is given height above sea level, mean annual temperature and climatic type of each station.

	Jammu	Srinagar	Leh
(*a*) Altitude	366 m	1585 m	3505 m
(*b*) Mean Annual Temperature	24·5°C	13·3°C	5·3°C
(*c*) Climatic Type	Sub-tropical	Temperate	Arctic

Though all the stations are located in sub-tropics, altitude modifies the climate of Srinagar to *temperate* and that of Leh to *arctic.*

(*iii*) **Terrain.** At least six mountain ranges run parallel to each other in J & K. Some of these act as climatic barriers. They check the

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onward movement of moisture laden winds. The Pir Panjab is the first high barrier, particularly with regard to south-west monsoon. Kashmir region, consequently, receives less rainfall than Jammu. The Great Himalaya acts as the second barrier. The Ladakh region lies in its rain shadow. The distribution of total annual rainfall at these three stations is given below.

Total	Jammu	Srinagar	Leh
Annual Rainfall (mm)	1052	664	92

It is evident that in J & K rainfall, like temperature, also decreases as we move from south to north. Ladakh can safely be identified as an arid region. It is also interesting to note that in each region the western sections receive more precipitation than the eastern sections.

(*iv*) **Distance From Sea.** J & K state lies far away from the sea in the interior of the continent. It is characterised by extremes of temperature. This high range of temperature introduces the element of *continentality* in its climate. As we proceed from south to north the continentality also increases. The simple reason being that in doing so we move farther away from the sea. This is evident from the following table.

ANNUAL RANGE OF TEMPERATURE [°C]

		Jammu	Srinagar	Leh
(*i*)	Distance from Jammu	0	294 km	637 km
(*ii*)	Mean Temperature of the hottest month	34·0	24·6	17·3
(*iii*)	Mean Temperature of the coldest month	13·5	1·0	—8·2
(*iv*)	Annual Range	20·5	23·6	25·5

(*v*) **Prevailing Winds.** During summer the state is under the influence of south-west monsoon. In winter the state lies in the path of western disturbances. The winter rainfall in the lowlands and snowfall in the highlands is because of these cyclones.

We shall now discuss the weather and climate of each region separately.

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(A) SUB-TROPICAL JAMMU

In this region we include most of the Jammu province except the highland areas of Bhaderwah, Kishtiwar Gool-Gulabgarh, and Banihal where climate is more akin to temperate Kashmir.

The mean monthly temperature, total monthly rainfall and relative humidity of Jammu City is given below.

Mean Monthly Temperature [°C]

J	F	M	A	M	J	J	A	S	O	N	D
13·5	16·4	21·1	26·7	32·4	34·0	30·5	29·0	28·5	27·1	21·7	14·5

Total Monthly Rainfall [*mm*]

J	F	M	A	M	J	J	A	S	O	N	D
57	61	50	32	23	70	320	249	123	29	07	31

Relative Humidity [%]

J	F	M	A	M	J	J	A	S	O	N	D
68	63	54	42	32·7	45	71·4	80	69	55·7	49·3	63

(*i*) *Temperature*. The mean monthly temperature remains above 13·5°C throughout the year. This gives this region a year round growing season. June is the hottest month and January the coldest. The coldest period, by tradition, is around *Lohri* which falls on 13th January. In June the day temperature, at times, shoots to 46°C. These temperature conditions are more true of Jammu Plains and Outer Hills. In the Middle Mountain region altitude modifies temperature.

(*ii*) *Rainfall*. Most of the rainfall, about 60%, is received during the summer months of July to September. Some rain, about 14%, falls in the cold season. May-June and October-November are generally dry.

(*iii*) *Humidity*. The humidity is very high during July to September. It is above 69% during this period. The high rainfall coupled with high temperature result in high humidity. May has the least humidity. It does not fall below 60% from December to February.

Seasons. The climate of sub-tropical Jammu is monsoon type. The year is divided into following four seasons :

(*a*) *Cold season*. This season lasts for three months *i.e*. December to February. The mean monthly, temperature during this season is between 13·5° to 20°C. While the days are often sunny and warm

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nights are cold. 150 mm. of rainfall is received during this season. It rains in the lowlands and upland but precipitation takes the form of snow in highland. Occasionally a thin film of snow covers the Trikuta peaks. The rainfall is valuable for *rabi* crops particularly in un-irrigated areas and in kandi.

(*b*) *Hot season.* Temperature begins to rise above 20°C in March. It continues to rise up to June, when mercury rises above 40°C. The weather is mostly dry and very hot. The landscape puts on a brown appearance, the tanks dry up and the water table falls. Much discomfort is experienced at night, one week prior to the onset of monsoon.

(*c*) *Rainy Season.* South west monsoon arrives in Jammu by July 7. The showers are refreshing and give relief from intense heat. The landscape gets transformed from brown to green. The streams and ravines overflow and so do tanks and wells. It is time for paddy cultivation. But the monsoon is fickle. It arrives too early or too late. There may be to little or too much of rainfall. Humidity is quite high.

(*d*) *Seasan of Retreating monsoon.* Monsoon withdraws from Jammu by 14th September. There is a complete reversal of the direction of these winds from south-west to north-east. In October and November the weather is generally dry. The temperature begins to fall in July decreased to 27° in October and 21°C in November. It is the time for the harvest of *kharief* crops.

(B) TEMPERATE KASHMIR

Included in this climatic region is the entire Kashmir valley and those parts of Jammu province which are too high for sub-tropical climate. The climatic data of Srinagar is given below :

Mean Monthly Temperature [°C]

J	F	M	A	M	J	J	A	S	O	N	D
1·0	3·5	8·4	13·4	17·9	21·7	24·6	23·9	20·5	14·1	7·7	3·5

Total Monthly Rainfall [*mm*]

J	F	M	A	M	J	J	A	S	O	N	D
73	72	104	78	63	36	61	63	32	29	17	36

Relative Humidity [%]

J	F	M	A	M	J	J	A	S	O	N	D
88	87	84	77	71	75	73	79	77	82	85	88

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(*i*) *Temperature*. For five months in a year *i.e.* from November to February, the mean monthly temperature in Srinagar is below 10°C. Such a low temperature does not favour cultivation of crops. The growing season begins by March 21, and lasts upto the end of October. The hottest month is July when the day temperature, occasionally, rises to 33°C. Sub zero temperature is common during winter. The spell of severe cold lasts for forty day from December 22, onwards. This period is known locally as *Chillai Kalan*.

(*ii*) *Rainfall*. Winter precipitation is generally in the form of snow. March April and May receive maximum rainfall. About 20% of the total rainfall is received in the months of July-August which is caused by south-west monsoon. For the rest of the year the weather remains mostly dry. The increase of temperature is followed by decrease in rainfall. Paddy, the principal crop of this region, has to depend on irrigation for its cultivation and growth.

(*iii*) *Humidity*. The region experiences high humidity throughout the year. In no month is it less than 70%. High temperature and high humidity particularly during July-August cause lot of discomfort.

Seasons. The year in Kashmir is divided into four seasons. There is one hot and one cold season and in between these are two warm seasons. The winter season is the longest and spreads over five months. The summer lasts for four months. There is a transition season of two months between winter and summer and another transition season of one month between summer and winter [*Kaual, A.K. *Seasons of Kashmir Valley*, Geographical Review of India, Calcutta, Vol. 41, No. 2, June 1979, Pages 123-130].

(*a*) *Winter*. The main features of this season are low temperature, high precipitation and high humidity. It lasts from November to March. Frost is common. Snow falls during this season. Heavy woollens are to be used as a protection against severe cold. A heating device, like a *Kangri* or a stove, is a must.

(*b*) *Spring*. It marks the first transition from cold to hot season and lasts for two months—April and May. Vegetation which lay dormant during winter is revived. Leaves appear on the trees and so do blossoms on fruit trees. Agricultural activities begin. Rise of temperature above 10°C and sufficient rainfall are helpful.

(*c*) *Summer*. Mean monthly temperature from June to September

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remains above 20°C. Monsoon showers fall during July and August. Weather during these two months is muggy. Ideal conditions are obtainable for the growth of vegetation.

(*d*) *Autumn*. October is a warm dry month favourable for the ripening of temperate fruit. It is the harvest time. It is the busiest time of the farmer. He has to reap the fruits of his labour. At the same time he has to prepare for the ensuing bleak season. He has to store food, fodder and fuel. Leaf fall takes place towards the close of this month.

(c) ARCTIC LADAKH

Too cold and too dry are the chief characteristics of the climate of Ladakh. Cold desert conditions prevail in this region. The climatic data for Leh is given below.

Mean Monthly Temperature [°C]

J	F	M	A	M	J	J	A	S	O	N	D
—8·2	—5·3	0·2	5·8	10 1	14·3	17·3	16·5	12·3	6·1	0·2	—4·9

Total Monthly Rainfall [*m m*]

J	F	M	A	M	J	J	A	S	O	N	D
10·9	·76	8·9	6·1	5·3	4·8	12·7	16·5	9·1	3·1	1·8	5·8

Relative Humidity [%]

J	F	M	A	M	J	J	A	S	G	N	D
50	46	42	32	26·5	25·5	34	35·3	31·5	28·7	34·7	43·0

(*i*) *Temperature*. The mean temperature of Leh is below zero degree Celsius for three months—from December to February. This is the period of intense cold. For another four months—March and April, October and November—it remains below 10°C. The warm season with temperature between 10°C and 18°C lasts from May to September. This period constitutes the growing season of this region.

The sky is clear and free from clouds. The sun shines fiercely. The air is thin and rarefied. There is a considerable difference between shade temperature and the temperature in the open. Some of the water courses remain frozen till noon, when temperature is high enough to set in thaw.

Kargil at a lower altitude is slightly warm. Special mention be made of Dras, a station on the leeward side of the Great Himalayas.

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This is the second coldest place in the world with a mean minimum temperature of —22°C in January. The lowest temperature recorded is —45°C.

(*ii*) *Rainfall*. Aridity is the second main feature of the climate of this region. The total annual rainfall is 92 mm. 31% of this meagre rainfall is received in the months of July and August. The third month with a rainfall of more than 10 mm is January. The snow that falls in winter is so powdery that it is swept from the flat roof with a broom. The ice crystals in it are frozen hard due to intense cold.

(*iii*) *Humidity*. The aridity of the region is evident from its humidily as well. In no month the relative humidily is above 50%. May and June have the least humidity. It is highest in the months of December to February.

As the atmosphere in Ladakh is rarefied due to altitude, here the insolation and the radiation take place unchecked. There is sufficient difference between the day and night temperature. One room in almost every house is provided with a glass-front in order to take advantage of the unobstructed sunshine. In the absence of the locally available fuel this is an ideal arrangement for providing warmth.

In this high mountainous region the climate is vertical. Some mountains receive adequate quantities of precipitation. The snow-fed water courses which run down the mountains have been utilised for irrigating croplands. These snow-fed or spring-fed water courses make cultivation possible in this highland region. Since such water courses are few and far between, the villages too lie scattered and far away from one another except in the Indus lowlands.

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4

FORESTS

The type of vegetation found in J & K is typical of Western Himalayas, of which it is a part. In the provinces of Kashmir and Jammu the terrain is mountainous and rainfall sufficient to favour tree growth. The cold and arid climate of Ladakh region is unfavourable for the growth of forests. If we take the total geographical area of the state and find the percentage of forested area, it is as low as 12·9%. In a discussion on forests of J & K Ladakh regions needs to be excluded. In that case the total area of J & K under commercial forests is 27% of the total geographical area. 57% of this forested area lies in Jammu province and the rest i.e. 43% in Kashmir province.

The distribution of forest types depends on a number of factors like altitude, soil, precipitation, and aspect. In J & K as we proceed from south to north the altitude increases, temperature and rainfall decrease. The soils are depleted, stony and thirsty in the ravine infested lowland and kandi region of Jammu. The Siwalik slopes that face the plains have a southern aspect. Natural vegetation thrives best on northern and sheltered slopes. The precipitation in the highland regions of Jammu and Kashmir in winter is mostly in the form of snow. All these factors have combined to give rise to a variety of vegetation which ranges between tropical and alpine types.

(i) **Dry savanna and scrub vegetation** : This type of vegetation is found in the Jammu plains and kandi region. In the ravines with stony beds and sand grow, here and there, tufts of tall grass called *khar*. The grass is coarse and is used for thatching. The hill slopes when looked from a distance present a green appearance. They are clothed with a forest comprising acacias and an undergrowth of thorny bushes and an evergreen shrub. The tree species are *kikar* (*Acacia arabica*), *Phulai*

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(*Acacia modesta*), *ber* (*Zizyphus jujuba*), and *shisham* (Dalbergia sisso). The evergreen shrub is *aak or brenkar*. The other trees found in this zone are pipal, banyan, toon, simal, mango and palm. There is a bamboo forest at Jasrota. Khair (*Acacia catechu*) is found in Basohli area. *Shesham* is prized for its timber. It is a hardwood tree and used in making furniture. Khair tree is utilised for the production of *katha*.

(ii) **Sub-Tropical Forests.** These are found at an altitude of 900 to 1500 m in the sub-tropical region of Jammu. These occupy the inner and higher slopes of the Siwalik hills. The most important tree of this forest is *chir* pine (*Pinus longifolia*). This tree is valued for its timber. It yields resin, which of late has been in great demand as an industrial raw material. The important *chir* pine localities are Reasi, Udhampur, Poonch, Rajauri, Billawar, Jammu and Ramban. The total area (in 1981-82) under this forest was 1767 sq. km.

(iii) **Monsoon Temperate Forests.** These forests consist of both coniferous and broad leaved species. These are found between the altitudes of 1500 to 3350 m. The conifers include deodar (*Cedrus deodara*), blue pine or kail (*Pinus wallichiana*), silver fir (*Abies pindrow*) and himalayan spruce (*Picea smythiana*). The broad leaved species include maple, oak, walnut and poplar. These forests are found in Kashmir as well as in Jammu.

Forest Area By composition

(1981-82) (in sq. km.)

(A) Coniferous [Soft wood]

(*i*)	Chir	176
(*ii*)	Deodar	1108
(*iii*)	Kail	1785
(*iv*)	Fir	3019

(B) Non-Coniferous [Soft & Hardwood] 495

Deodar. It is a valuable timber for it stands moisture and termites. In Kashmir it is used for building different kinds of boats, including house boats. It is extensively used within the state and outside it for making doors, windows, beams and as railway sleepers. Excellent deodar forests are found in the upper chenab valley where south-west monsoon gives copious summer rainfall. The deodar logs extracted

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from the forests of Kishtiwar, Bhaderwah and Doda are floated down the Chenab and collected at Ramban. Deodar forests in Jammu are also found in Udhampur and Billawar divisions. In Kashmir deodar forests are found in the northern divisions of Kamra), Langet and Jhelum valley. The deodar forests of Lolab are quite famous.

Blue Pine or Kail. These forests in Kashmir are found in Anantnag, Sindh, Pir Panjal, Langet, Kamraj and Jhelum Valley divisions. Bhaderwah, Doda, Ramban and Reasi division, of Jammu province have large areas under forests of *Kail.* This timber also is used for making doors and windows.

Silver Fir. Fir wood is inferior in quality, as timber, when compared to deodar or blue pine. But the area under this species far exceeds the combined area of deodar and *Kail.* Fir forests are found in Sindh, Pir Panjal, Anantnag, Langet, Kamraj, Bhaderwah, Kishtiwar, Poonch, Rajauri, Billawar and Reasi divisions. Fir is found mixed with spruce but pure fir forests are also common. At some places kail is also associated with fir forests.

Non-coniferous. In Jammu province the common trees belonging to this category are maple, oak, walnut and poplar. In the forests of Kashmir oak is almost absent. The other important species are bird-cherry, horse-chestnut, ash, elm, alder and hazel. *Pohu* (*Parrotia Jacquemontiana*) is an important undergrowth.

(iv) **Alpine Vegetation.** This zone lies at an elevation of 3350 to 4570 m. Above this is the regoion of rock and snow. With the increase in elevation the fir trees are replaced by Alpine brushwood of Juniper and high level rhododenderon. Clusters of birch trees and stunted willow are also found in this zone. Above the trees lie vast grassy expanses called *bahaks*, *nais* or *alps.*

Pastures. Blanks and gaps in the commercial forest zone of fir and pine constitute the pasturelands. Some of these meadows or *margs* are the famous tourist spots in Kashmir like the Gulmarg and the Yusmarg. The Alpine zone also contributes the pastures of J&K. *Gujjars*, *Bakerwals*, *Gaddis*, shepherds and ponymen frequent these pastures in the favourable season, with their flocks and herds. These pastures, seemingly, are overgrazed.

Forest Products. Forest products are grouped as (a) Major produce

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and (b) minor produce. Timber and firewood extracted from the forests belongs to the first group. In 1981-82 the total quantity of timber and firewood obtained from the forests of J & K was 597,000 and 219,000 cubic metres respectively. The total area exploited was 349 sq. km. The value of the major produce was Rs. 8,766 lakhs. Specieswise outturn of timber and fuel is given below :

(a)	Chir	16,560 cm.
(b)	Deodar	163,150 ,,
(c)	Kail	182,230 ,,
(d)	Others	454,600 ,,
	Total	817,760 ,,

Out of this 315,340 cubic metres of timber was exported.

The *minor produce* includes medicinal herbs like artmesia, belladona, pyrethrum, dioscorea, digitalis, colchicum, podophylum etc. The other products include tanning materials and *Katha*.

State Forest Department has established a factory at Baramulla for the manufacture of half wroughts. For this purpose timber of such non-coniferous species as maple, birdcherry and walnut is used for the manufacture of fore-ends, and hand guards of guns. These are supplied to Defence Department for use in their rifle factory. State government supplies deodar sleepers to Indian Railways.

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5

MINERALS

Mineral wealth in our country is mostly found in peninsular India. No significant minerals have, so far, been reported from other parts of Himalayan region. Our state holds a place of pride in possessing some industrial rocks and minerals. Mineral fuel deposits consist of coal and lignite. Petroleum exploration has not yielded favourable results. The important rocks and minerals are limestone, gypsum, quartzite, bauxite, sapphire and marble. These have been explored in detail. Their quality and quantity has been assessed. Some of these are being mined and used for industrial purposes. While others await exploitation. Below is given the distribution of these rocks and minerals.

(i) *Coal.* Coal and lignite deposits of J & K are of great importance for these are the only deposits of mineral fuels found so far in the western Himalayas. Coal deposits of Eocene age are found in the Nummulitic limestones which occur as inliers in the Murree series, in the districts of Udhampur and Rajouri. The coal deposits are found at Kalakote, Mahogala, Metka, Dhansal—Sawalkote, Chakar, Dandil, Ladda, Chinkah and Kura. The estimates of coal deposits made by Middlemiss appeared, on actual mining, to be too exaggerated. The coal though of anthracitic quality is soft and friable. A thermal power plant was set up at Kalakote to use the coal for the generation of electricity. 34·5 thousand tonnes of coal were mined during 1981-82.

(ii) *Lignite.* Lignite deposits in J & K occur in the Karewas of western Kashmir from the valley of Shaliganga stream upto Chowkibal. Huge deposits of lignite are present at Nichahama in Handwara tehsil. Lignite mined at Nichahama is sent to the briquetting plant at Shalateng near Srinagar. Lignite briquets are used as fuel in stokes in government offices. Lignite, also called brown coal, is an inferior kind of fuel. Kashmir lignite contains only 7 to 20% of carbon, the rest being ash. Lignite extracted during 1981-82 was 5·2 thousand tonnes.

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(iii) *Limestone*. Limestone deposits of different ages and grades exist in all the three regions of J & K state. The deposits of Kashmir have been used for the manufacture of cement in the factories at Wuyan and Khrew. The limestones of Kashmir are of high quality and can be directly used in the manufacture of cement. Huge deposits occur at Aishmuqam, Mattan, Anantnag, Achabal, Doru, Verinag, Biru, Sonamarg, Ajas, Wuyan, Khrew and Loduv. In Kashmir it is used as building stone and for making tomb-stones and mortars.

Limestone deposits of Jammu province need improvement prior to their use in cement manufacture. The two important limestone areas in Basohli tehsil are Banjalgala and Siara. A cement factory is coming up to utilise these reserves. Limestone deposits are also found in Jangalgali, Muttai, Salal and Reasi.

(iv) *Gypsum*. Gypsum forms an important industrial raw material. It can be used in the manufacture of cement, fertilisers, sulphuric acid, plaster of paris and gypsum board. Gypsum of good quality is found in Uri tehsil. Two parallel bands of gypsum deposits run on the right bank of the Vyeth between Ijara and Dhani-Saiydan. Good quality gypsum occurs in Ramban—Batote-Assar area. 700 tonnes of gypsum were extracted in J & K during 1981-82.

(v) *Quartzite*. Sizable deposits of quartzite suitable for the manufacture of glass are found in Gugaldar and Aishmuqam in Anantnag district.

(vi) *Bauxite*. Bauxite is a hydrated oxide of aluminium and is found as a buff or reddish rock. It is used in the manufacture of aluminium and refractories. Extensive deposits of high grade bauxite occur in Chakar, Salal, Panhasa, Sangarmarge. Sukhwalgali and Khander in the districts of Udhampur and Rajouri. This aluminium ore is associated with the Nummulitic rocks of Jammu province.

(vii) *Sapphire*. Sapphire is blue coloured corrundum—an oxide of aluminium. It is valued as a gem and is next only to diamond in hardness. Sapphire obtained from our state is famous all over the country for its colour and brilliance. Its deposits were discovered a century ago.

Sapphire mines are located in the Padar area of Kishtwar tehsil. Sumjum is the name of the village from which sapphire mines can be approached. The old mine is 4 km to the northwest of this village.

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The new mines are at the same distance from Sumjum but in the south-west. The mines lie at an altitude of 4510 to 4560 m. and the area remains snowbound for the major part of the year. The gem occurs in the pegmatite rocks. The rocks after mining are crushed and washed and the gem hand picked. The mining season lasts from June to September. Sapphire worth one lakhs rupees was collected during 1972-73.

(viii) *Marble.* Large workable deposits of marble have been explored in Kupwara district. The quarry sites are Drugmulla, Zirahama, Oura and Trehgam. The marble is of light brown to dirty grey colour. An industrial unit has been set up at Hiri in Zirahama for mechanical dressing, cutting and polishing of marble. More such units shall be installed soon. Marble is also found at Thathri in Doda district.

There are some rocks and minerals in J & K which are under exploration. These will be our potential resources. Their distribution shall be presented regionwise.

JAMMU

(i) *Barytes.* Thin veins of barytes are associated with the lime-stones of Riasi, Jangalgali and Kherikot.

(ii) *Clays.* Clays suitable for use in cement manufacture are found in Siwalik and Murree formations.

Bentonite, a plastic clay, used to check leakage of water from canals and earth dams occurs in Jammu and Kathua districts. A 2·5 m. thick bentonite bed is found in Uttarbeni—Purmandal area.

KASHMIR

(i) *Graphite and Ochre.* Deposits of graphite and ochre (red and yellow) are found in Uri tehsil.

(ii) *Clays.* Clay required for the manufacture of cement is available in the Karewas.

LADAKH

(i) *Borax.* Borax is found in the form of surface deposits in the Puga Valley and Chumathang—Mahe yang area. It is deposited as a result of the evaporation of the water of hot springs. It is the only known economical source of borax in our country. 12 tonnes of borax were obtained in 1981-82.

(ii) *Sulphur.* Extensive deposits of elemental sulphur have been located in the Puga Valley. These are deposited through the hot springs of the area.

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6

AGRICULTURE

India is an agricultural country, where 70% of the population is engaged in agriculture. J & K is no exception to this general condition. Here the percentage of workers involved in agriculture in (1981) was 61·5.

The total area of J & K according to village papers in 1982 was 24·15 lakh hectares. Its classification is given below, in lake hectares.

(a) Area Under Forest	6·60
(b) Area not available for cultivation	5·74
(c) Other uncultivable land excluding fallows	3·56
(d) Fallow Land	1·02
(e) Net Area Sown	7·16
Total	24·15

Out of the total area only 30% is available for cultivation. This is much less when compared with the national average of 45%. The distribution of the total and net sown area is given below, in lakh hectares.

Region	*Total Area*	*Net Sown Area*
(a) Jammu	17·94	3·59
(b) Kashmir	5·58	4·48
(c) Ladakh	0·63	0·19
Total	24·15	7·16

There are some environmental constraints which do not permit full utilisation of available land resources for agriculture. In sub-tropical Jammu it is the lack of water—rain or irrigation—which is the main hindrance. In Kashmir the great impediment is the low temperature because of which no agricultural activity is possible in winter. In Ladakh region it is both –low temperature as well as lack of water. In Ladakh

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only that area of land can be cultivated as is watered. The low temperature favours only a special set of crops for cultivation. A very small portion of the cropland is sown more than once. Here the sub-tropical Jammu contributes the largest share. The total area sown more than once is 2·62 lakh hectares. The regionwise distribution is as under :

Region	*Area sown more than once*
(a) Jammu	2·231
(b) Kashmir	0·373
(c) Ladakh	0·016
Total	2·620

Like other states of the country, agriculture has received sufficient impetus for its improvement since the inception of the Five-Year Plans. Area under irrigation has considerably increased as a result of minor and medium projects. Farmers have become aware of the need of inputs for increasing agricultural produce. They know the significance of using improved and high yielding varieties of seeds, farm yard manure and chemical fertilizers, insecticides and pesticides, scientific methods of farming, iron ploughs, tractors and other farm machinery. Credit facilities are made available to them through co-operative banks. Government agencies purchase his surplus produce at the prices revised from time to time. There is no denying the fact that agriculture in J & K has undergone transformation but the 'Green Revolution' in the form witnessed in the neighbouring state of Panjab has yet to make its appearance in this state.

The agricultural crops of J & K are maize, paddy, wheat, coarse grains, oil seeds, fodder etc.

(i) *Maize*. The largest acreage (38%) of the net sown area in J & K is under maize. Maize is a *Kharief* crop and is raised on dry, unirrigated areas including hill slopes. The crop is dependent for its growth on rainfall. Maize floor baked into bread is the stable food of a large number of people living in hilly areas. Maize stalks constitute an important feed for cattle. Out of 2·78 lakh hectares under maize cultivation in J & K, 1·00 and 1·78 lakh hectares are in Kashmir and Jammu province respectively. Maize cannot be raised in the Ladakh region. Important districts of maize production are Udhampur, Doda,

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Rajouri, Baramulla, Anantnag, Poonch and Kupwara. The production of maize in 1981-82 in Jammu province and Kashmir Valley was 36·4 and 9·6 lakh quintals, respectively.

(ii) *Rice*. Rice happens to be the staple food of the majority of the population of J & K. Despite large paddy production in the state sizable imports of rice are made to meet the requirements of this cereal. Area under paddy cultivation is 2·6 lakh hectares. More than two thirds of this acreage is in Kashmir province. Rice is a *Kharif* crop. It is raised in both the provinces with the help of irrigation. Certain areas in sub-tropical Jammu, like Kirmchi in Udhampur, raise paddy without irrigation. A Kashmiri farmer takes extra-ordinary care and pains in the cultivation of this crop. With fertile alluvial soils, abundance of canal water for irrigation, adequate amounts of manures and fertilizers, he works hard to get maximum yield of paddy from his land holdings. The yield per acre of paddy in Kashmir is 25·4 quintals against 13·0 quintals in Jammu province.

Paddy cultivating districts, in order of acreage, are Jammu, Anantnag, Baramulla, Pulwama, Badgam, Kathua, Kupwara, Srinagar and Udhampur.

In Jammu province paddy is cultivated in the Outer Plains, *Doon* region and the valley of Bhaderwah. In Kashmir province it is raised in the Vyeth Plain as well as on irrigated Karewas. Fine *basmati* rice raised in Ranbirsinghpora is exported to the Middle East and other countries of the world. Paddy cannot be cultivated in the Ladakh region. The production of rice in the provinces of Kashmir and Jammu during the year 1981-82 was 42·2 and 12·8 lakh quintals respectively.

(iii) *Wheat*. It is a rabi crop. It accounts for 28% of the net sown area. Wheat cultivation is almost restricted to Jammu province. Out of a total of 2·00 lakh hectares under wheat in J & K, 1·93 lakh hectares are in Jammu province. In the Jammu Plains wheat is irrigated but in the hills and mountains its cultivation is entirely dependent on rainfall. Jammu district has the largest acreage under wheat cultivation. It is followed by Kathua, Udhampur and Rajauri.

Wheat is cultivated in 3,100 hectares of land in Kashmir province. But the continued low temperature upto middle of May does not help in its ripening in most places. As the same plot of land is to be used for the cultivation of paddy, the unripe wheat is cut and served as green

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fodder to the famished livestock who, on account of winter, are fed indoors on dry grass.

It is quite heartening to know that 3,660 hectares of land in Ladakh region are under wheat cultivation. It is, unlike rest of the state, a summer crop. It is sown in May and harvested in September. Two thirds of total area under wheat cultivation is confined to the Indus lowland around Hemis. The remaining area is in the Kargil district. The total production of wheat in the regions of Jammu, Ladakh and Kashmir, in 1981-82, was 19·9, 0·27 and 0·13 lakh quintals respectively.

(iv) *Millets and Coarse Grains.* In elevated areas where growing season is short and temperature low millets and coarse grains replace paddy and maize. These include *grim*, *tromba*, *shola*, *pinga* or *chena*.

Grim : It is an important cereal of Ladakh region. It is a hardy variety of barley which is beardless. It is well adapted to the soil and climatic conditions of this region. Ten thousand hectares of land are under grim. It accounts for 55% of the net sown area. Most of it (about 60%) is in Kargil district and the rest (40%) in Ladakh district. In *Sham* region it is sown in April and harvested in July. In this zone pea is also raised along with *grim* in the same field. After July the land is used for raising a second crop of turnips. In *stot* region sowing of grim takes place in May and it is harvested in September. Here pea is raised in separate fields.

Grim is roasted and then ground into flour to make *sattu*. It is used in several ways. Grim goes into the preparation of a local brew called *Chang*. Grim enters into local trade as some farmers produce more than their requirements. The total production of grim in Ladakh region in 1981-82, was 27,000 quintals.

In the Kishenganga Valley of Kashmir province the chief (cereals) in Gurez and Titel are *chena* and *tromba*. Here chena is sown in the first week of June and harvested by middle of September. Tromba is sown by 21st of June and harvested in the last week of August.

In the Sindh Valley of Kashmir province paddy beyond Gund is replaced by *shola*.

(v) *Bajra* and *Barley*. Cultivation of these crops is restricted to Jammu Province. Bajra is a *Kharif* crop. It is raised in Kandi area of the districts of Jammu, Udhampur and Kathua. Total area under this cereal is 15,800 hectares. Barley is a rabi crop. It is cultivated in 8,700

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hactares of land in the districts of Doda, Kathua, Udhampur and Jammu. Both of these crops depend on rainfall.

(vi) *Pulses* and *Oilseeds*. The total area under pulses and oileeeds in 1981-82 was 48,540 and 53,180 hectares respectively. More area in Jammu province is under pulses than oilseeds, while reverse is the case in Kashmir province. Pulses particularly peas and beans are cultivated in a thousand hectares of land in Ladakh region.

(vii) *Fodder Crops*. In the farm economy of Kashmir province no provision is made for raising animal feeds. No part of the land holding is reserved by a farmer here for raising fodder crops. Livestock is mostly fed on wild growing grasses and on weeds in summer. The winter feed consists of the dried stalks of either maize or paddy. Lately cultivation of oats has been introduced on experimental basis on land left fellow after paddy harvest. It is only in the mountainous areas of Baramulla district like Gurez, Tilel and Karnah that fodder crops are sown in three thousand hectares.

In sub-tropical Jammu a parcel of land is reserved for fodder cultivation. The livestock, particularly in the canal irrigated areas are fed on green fodder throughout the year. Largest acreage under fodder crops is in Jammu district. This is followed by Kathua, Rajauri and Poonch. The total area in Jammu province under fodder crops is 15,000 hectares.

In Ladakh region fodder crops are raised on four thousand hectares. Three fourths of this area is in Kargil district.

Fruit Cultivation. In Kashmir the soil and climatic conditions favour the cultivation of temperate fruit. The area under orchards increased to 1,09,000 hectares in 1982 and the fruit production rose to 5·28 lakh tonnes. The annual turnover of fruit industry in Kashmir has risen to Rs 50 crores. The fresh fruits raised here are cherries, plum, apricot, quinces, peach, pear, *trel* and apple. Almonds and walnuts are the dry fruits.

Fruit cultivation is carried out in all districts of Kashmir province. The two districts with largest acreage under fruit are Baramulla and Pulwama.

Fruit, mostly subtropical, like lime, guava, mango, *locat* and chekhu and temperate like apples are raised on five thousand hectares in Jammu province.

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One thousand hectares of land in Ladakh is under fruit trees. The most important fruit of this region is apricot. Dried apricots are exported from Kargil to other parts of the country. The other important fruit is apple.

Saffron. It is a cash crop which is raised on the Karewas in Kashmir Valley. The corm of saffron is planted in specially made square beds in the month of July-August. Each bed measures 1·5 m. It is provided with a narrow trench on all sides to prevent the accumulation of water. The safforn plant flowers in October. The flower has a purple colour. The red coloured stigmas of the flower are picked by hand. This forms the superior grade saffron. The rest of the flower is processed and a second grade saffron is obtained. The corm remains in the soil for a long period.

Saffron cultivation at one time was restricted to the Karewas of Pampore. But its cultivation has, of late, spread to other Karewas as well. The intervening space between the trees in an almond orchard is being utilised for saffron cultivation on some Karewas.

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7

IRRIGATION

Irrigation plays a vital role in the agricultural economy of J&K where 40% of the total cropped area is irrigated. The temperature conditions in sub-tropical Jammu favour cultivation of crops throughout the year. The limiting factor for plant growth in this part of the state is non-availability of water. The rainy period is restricted to the summer months of July to September. Several showers of rain are received during the cold season. Weather remains dry for rest of the year. The problem could be solved by irrigation. The terrain of the region, undulating ground, porous soils and a low water table are some of the several impediments that inhibit extension of irrigation facilities to more areas. In Jammu province 25% of the total sown area is irrigated.

In Kashmir province the periods of adequate precipitation do not keep pace with rising and favourable temperature. It rains most in the Valley, when temperature is too low for plant growth. When the temperature begins to rise May onwards the rainfall decreases. Except for some showers during July-August most of the growing season remains dry. Since for millennia the farm economy has been dependent on a single crop, the peasant could ill afford to take chances with it. He always needed an assured supply of water for his fields and he strove for it. With number of snow fed streams running down the slopes of the mountain girdle and presence of the soft rocks cannal construction became quite easy for him. Today 60% of the total sown area in this province is irrigated.

Ladakh region, as a cold desert, lacks in both suitable temperature and adequate water for plant growth. The growing season is short. Agriculture is entirely and completely dependent up on irrigation. Every acre of arable land needs to be watered. Even the tree-crops need

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water for the rainfall is too low for tree growth. Mostly canals, of small length, are drawn from a spring or a mountain source. To put it differently the villages have sprung where this facility of water for irrigation was available. It is for this reason that in Ladakh 100% of the total area sown is irrigated. The following table reveals this :—

		Jammu	Kashmir	Ladakh	J & K
(*i*)	Total Area Sown (000 Hectares)	576	381	19	977
(*ii*)	Total Area Irrigated	144	233	19	396
(*iii*)	% of Irrigated area	25	60	100	40

Methods of irrigation employed in J & K are canals, tanks, and wells. But canals account for 94% of the total irrigated area. Let us study this source regionwise :—

JAMMU

The rivers and streams flowing through Jammu province are the Ravi, the Chenab, the Tawi, the Ujh, the Basantar, the Manawar Tawi, the Poonch Tohi, the Neru. Most of the canals of this province have been drawn from these rivers. We select a few canals for discussion.

(*i*) *The Ranbir Canal.* This canal has been drawn from the left bank of Chenab at Akhnoor. From Akhnoor to Jammu it passes along the highway. It crosses the Tawi in Jammu, through a subway below its bed and then flows towards Ranbirsinghpora. It irrigates more than a lakh acres of land in the tehsils of Akhnoor, Jammu, and Ranbirsinghpora. In Jammu city a small power house has been constructed on this canal. The prosperity of agriculture in Jammu district is because of this canal.

(*ii*) *The Partap Canal.* Another canal has been taken off from the right bank of the Chenab at Akhnoor. The canal has been remodelled during II Five Year Plan. It has a length of 36 km and irrigates 20,000 acres of land in Akhnoor. It provides drinking water to 26 villages.

(*iii*) *Ravi-Tawi Irrigation Complex.* A major irrigation system called Ravi-Tawi Irrigation Complex is nearing completion in Jammu province. The purpose of this is to link the two rivers by a canal that would irrigate 1·5 lakh acres of land in the Kandi and plain regions. It comprises of gravity canals and lift-irrigation projects. The total cost involved is Rs. 64 crores.

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It consists of the following components :—

(*a*) **Tawi Lift Irrigation Project.** Water of river Tawi is raised to a height of 30·5 m by lift pumps and fed into the main canal. The lift station has been constructed on the left bank of the Tawi near Bahu Fort. The main canal is lined and has a length of 29 km. It runs from Jammu to Ramgarh. It irrigates 15,000 acres of land in the blocks of Jammu, Bishnah and Vijaypur.

(*b*) **Ravi Canal.** The canal is to utilise the state's share of the water of Ravi. The canal takes off from the right bank of the river from Shahpur Kandi Barrage. The total length of the canal is 76 km. It is to be linked with the Tawi Life Project canal at Vijaypur. The work of construction of Ravi canal has been taken up in three phases. The middle portion of the canal involved the construction of 356 m long barrage on the Uja and the main canal of 34 km. This part was commissioned in 1980. Several lift stations are to be constructed. One involves the transfer of water from Kathua canal into Ravi canal at Lakhanpur. The complex on completion will usher in an era of agri-cultural prosperity in the districts of Kathua and Jammu.

KASHMIR

Canal irrigation in Kashmir is characterised by the presence of *Zamindari* Kuhls constructed and maintained by the peasants of Kashmir. The total number of such *Zamindari* Kuhls is 2827. Our of these 259 have been taken over by the State Irrigation Department, recently. The state owned canals include Martand Canal, Zainagir Canal, Lal Kuhl Canal etc.

(*i*) *The Martand Canal.* This canal was originally constructed in 8th century A.D. by king Lalitaditya. It has been rennovated on several occasions. The present headworks of the canal are at Ganeshpur. It takes off from the left bank of the Lidder steeam. It irrigates large areas of Anantnag district. The canal ends on Martand karewa.

(*ii*) *The Zainagir Canal.* This canal has been constructed by Sultan Zain-ul-abdein during 15th century A.D., to irrigate a large tract of land in Zainagir pargana of District Baramulla. The canal takes off from the Madhumati stream at Sonarwani. It runs along the northern shore of the Wular lake, round the Baba Shukrudin hill, through Sopore to Zainagir.

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Cultivation of Padddy, the principal crop of Kashmir, is entirely dependent on irrigation. All paddy fields whether in the low lands or on uplands are irrigated by canals.

LADAKH :

In addition to scores of small, local and individual water courses that serve a particular village some canals have been built to irrigate sizable tracts of land particularly in the valley of the Indus. A canal in Ladakh is called *Mayur*.

(*i*) *The Chuchot Mayur*. This canal takes off from the left bank of the Indus at Stakna. It irrigates about 200 acres of land in the hamlets of Chuchut, Gongma, Shama, Yokma and Balam, for raising wheat and grim.

(*ii*) *The Thiksey Mayur*. This canal takes off from the right bank of the Indus to irrigate about 120 acres of land in Ranbirpora, in the Indus lowland.

OTHER METHODS OF IRRIGATION

Lift Irrigation. In certain parts of the state, water for irrigation is raised from lower to higher level by lift pumps mostly worked by electricity. Number of such schemes have been taken up in hand during the V and VI Five Year Plans. Some of these are already completed. The important lift irrigation schemes are Marval, Leta Pora, in Kashmir and Ranjan and Rajal in Jammu.

Wells. A total of 2,960 hectares of land in the districts of Jammu, Srinagar, Baramulla and Kathua are irrigated by wells.

Tanks. A small area of land is irrigated by tanks in J & K. Several irrigation tanks were built in Lolab valley sometime back.

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8

POWER PROJECTS

We need electricity not only to light our homes and streets but also to run our tubewells, lift-irrigation pumps, rural industries, trains, trams, machines and factories. Regular supplies of cheap electricity boost all round economic development of an area. Electricity is obtained by working a generator by a number of methods. When falling water is used to generate electricity, it is a hydro-electric project. It is a thermal power project when electricity is obtained by burning coal or natural gas. In a nuclear or atomic power project nuclear fuel is used for this purpose. In J & K electricity is produced by a number of hydro-electric projects. There is only one thermal and no nuclear power station is this state.

A hydro-electric power project, is generally, built in the mountain stage of a river. A power canal is built in that section of a river where the decrease in elevation of the ground is sufficient to help in the formation of a high fall. Water is fed into the power canal with the help of a diversion dam. In order to stabilise the flow of water a high dam is built across the river and the water collected in the form of a lake. The water from the power canal is made to fall through penstock on the turbines of generating sets, installed in the power station. The amount of power generated depends on the volume of water and the height of the fall. The water that leaves a power station is either used for irrigation or returned to the river. In a hydro-electric or hydel project the initial cost of construction of dam, power canal and power house particularly in the mountainous area of hard rock is too high. The project takes a long time in construction. But once the project is commissioned its cost of maintenance is less. A regular supply of cheap electricity is obtained from a hydel project. Since water is a replenshible resource it is used again and again for the generation of power. In a

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thermal power house coal is burned to boil water and produce steam. The generating set is worked by steam. Coal is an exhaustible resource. Whatever quantity of coal is burned, it is lost for ever. The burning of huge quantities of coal in a thermal power station causes pollution of air. A thermal station can be built within a short time.

The hydel projects of our state which produce electricity are :

(i) *Kashmir H-E Works, Mohara.* The second hydro-electric power project in Indian sub-continent was built in J & K in 1907, at Mohara. A ten kilometer long power canal is taken from the Vyeth at Buniyar. For most of its length the water is made to flow over a wooden flume made of deodar logs. The power house is at Mohara. The power house was destroyed by invaders in October 1947. It was repaired and resumed power generation. It was damaged by the flood of 1951. The power house has been re-built and latest machinery installed. The total installed capacity of the power house is 9 MW. In winter the power production drops down to 8 MW. The electricity is fed to state grid.

(ii) *Jammu H-E Power House, Canal.* It is a small power house built on the Ranbir canal in Jammu city. With Mohara, it is the second power house built in J & K before independence. The height of the waterfall is 2·5 metres and the electricity generated is 600 KW.

(iii) *Lower Sindh H-E Project, Ganderbal.* This power project was built during I Five Year Plan. A power canal has been taken from the left bank of the Sindh stream at Prang. The 14 km. long canal carries water to the power house at Ganderbal. The first phase of the project was commissioned in 1955. Electricity generated in the project is 13·5 MW, which in winter falls to 12 MW only.

(iv) *Sartangal H-E Power House, Bhaderwah.* This power house was completed in 1964. A 3 km. long power canal is drawn from the Helon stream. The power house is at Sartangal. It produces 700 KW of electricity which is supplied to Bhaderwah town.

(v) *Cheneni H-E Project, Udhampur.* In this power project water of the Tawi has been used for the generation of electricity. A diversion dam directs the water into the power canal at Cheneni. The power canal has a length of 20 km. It is built over a ridge of the Middle Mountains. At the power house near Udhampur the water falls through a height of 110 m. The project was inaugurated in 1971. It produces 18 MW of electric power.

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(vi) *Upper Sindh H-E Project, Sumbal.* A second hydel project was constructed on the Sindh stream at a place 35 km. up stream of Ganderbal. The power house is at Sumbal. A 11 km. long power canal brings water from Kulan. The project was inaugurated in 1973. It produces 18 MW of power in summer and only 12 MW in winter.

(vii) *Lower Jhelum Hydel Project, Buniyar.* This is the largest project, of its kind, built, upto this time, in J & K. It harnesses the water of the Vyeth (or Jhelum) for the generation of 105 MW of electricity. The first phase of the project was commissioned in 1978. In winter power generation falls to 70 MW.

There are a number of power projects which are under construction or proposed for construction in J & K. These are :

(i) **Salal Hydel Project, Reasi.** River chenab has a large potential for the generation of electricity. At Salal it takes a sharp bend. Here a dam is being constructed across the river to divert the water into an underground power house. The work on the project was started in 1970. Salal Hydel Project, on completion, in 1987, will produce 345 MW of electricity. The cost of the project has been revised to Rs. 350 crores. It is being constructed by the National Hydroelectric Corporation.

(ii) **Stakna H-E Project, Ladakh.** This, on completion, shall be the first hydro-electric power project in Ladakh region. The project will utilise water of the Indus to generate 4 MW of electricity. Work on the project was started in 1969. It is still under construction.

(iii) **Upper Sindh H-E Project (Phase II) Kangan.** The tail water of the Upper Sindh Project at Sumbal shall be carried by a 24 km. long power canal to Kangan. Into it shall be poured water from the Wangat nallah. The power house at Kangan shall have an installed capacity of 22.5 MW. This project shall be the third on the Sindh stream. The work on this project is in progress.

(iv) **Sewa Hydel Project.** This project is to be constructed in the Bani block of Basohli tehsil. The power house is to be built at Patyarna. The installed capacity of the project shall be 48 MW. The project is located in a mountainous area where construction work will involve lot of effort, time and expenses.

(v) **Dul-Hasti Hydel Project, Kishtiwar.** This shall be the second hydel project on the Chenab. At Dul Hasti, Kishtiwar a dam will divert

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water into a power canal. The power house shall be at Hasti 10 km. downstream from Dul. The power generated in the I phase shall be 330 MW. The project is estimated to cost Rs. 160 crores. The project shall be commissioned by 1994-95.

(vi) **Thein Dam.** A dam shall be built across the Ravi at Thein. The water stored shall be used for the generation of electricity and for irrigation. On completion in 1992-93 the share of electric power for J & K shall be 117 MW.

(vii) **Uri Hydel Project.** A third hydel project is to be built in the Vyeth (Jhelum) gorge at a cost of Rs. 240 crores to generate 480 MW of power. The power canal taken from Buniyar shall pass through a 10 km. long tunnel to reach Lagama, which is the proposed site of the underground power house.

Thermal Power Project.

A thermal power plant is located at Kalakote in district Rajauri. It lies close to the coal mines. The thermal power station has three units of 7·5 MW each. The total installed capacity therefore is 22·5 MW but only 6 MW of power are generated and that too occasionally.

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9

INDUSTRY

J & K lacked the development of large and medium scale industries. The main reasons have been the remote location of the state, its rugged terrain, absence of cheap and speedy transport facilities, want of mineral fuels or metallic minerals, paucity of agricultural raw materials, non-existence of private enterprise. The few industries that were there in this state, before independence, were in public sector. These depended for their raw materials up on sericulture and forests.

After independence and with the introduction of economic planning, due attention was paid to the development of industries all over the country and J & K could be no exception to it. In this connection Second Five-Year Plan has been of special significance. During this plan the first step taken towards industrial development in J & K was the establishment of industrial estates in Jammu and Srinagar. This was followed by setting up of industrial areas at district head-quarters and in major towns. A state public sector undertaking, J & K Industries Ltd., came into existence in 1963. It had sixteen industrial units upto 1981 which employed 5,000 workers. 1972 boosted up industrial development, particularly in Jammu, with the opening of a railway link upto Jammu city. In the small scale industries sector a major step taken was the establishment of district industries centres in 1978. Raw materials were made available to SSI units by J & K Small Industries Development Corporation (SICOP). Another agency responsible for setting up industrial complexes was J & K State Industrial Development Corporation (SIDCO). With liberal grants and loans from State Financial Corporation, nationalised banks, and other agencies the unemployed but educated youth was drawn and prompted to seek and utilise opportunities for self-employment and entrepreneurship. During the last decade the efforts taken in this direction

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have started showing signs of industrial activity and development in this state as is clear from the figures given below.

Number of Registered Factories in J & K with employment.

	1975	1978	1981
Number	375	483	575
Employment	18,563	20,784	23,537

Cottage Industries.

The people of this state had taken to cottage industries since early times. With little capital and low cost tools the artisans utilised the locally available raw materials for the production of a variety of useful and ornamental articles. The basic requirement was the artistic skill in which they did not lag behind. Some of these handicrafts have a market spread over the world, while others served the local needs. Several agancies have been looking after this industrial sector which has a large employment potential. It also provides seasonal employment opportunities to out of work farmers and farm labour. These aquencies are Handicrafts Development Corporation, Handloom Development Corporation and Khadi & Village Industries Board.

We shall present in the following pages sector-wise discussion of all types of industries.

PUBLIC SECTOR.

(a) Central.

(*i*) *H.M.T. Watch Factory, Zainakot.* This is the largest factory in J & K and employed in 1981-82 1,224 workers. It produced in the same year 4·4 lakh watches valued at Rs. 8·5 crores. It is a branch of H.M.T. Bangalore.

(*ii*) *Indian Telephone Industries, Hyderpora.* It is a branch of I. T. I. Bangalore which produces telephone parts and accessories. The value of production was Rs. 1·01 crores. Total number of workers in this factory is 142.

(b) State.

(*i*) *J & K Industries, Baramulla.* There are two units of this J & K Government undertaking in Baramulla. One produces pharmaceuticals like santonine and glanicals and the other matches. The raw material for the manufacture of santonine is artmesia.

(*ii*) *Rosin and Turpentine.* Rosin collected from the sub-tropical forests of Jammu province is to be refined before it is used as a raw

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material. There are three units one each at Miransahib, Sunderbani and Rajauri. These employ 313 workers and the value of annual production is Rs. 3,69 lakhs.

(*iii*) *Sole Leather Plant, Muthi.* This factory is engaged in the manufacture of leather for shoe soles. The number of workers in the factory is 46 and the total value of goods was 9·5 lakh.

(*iv*) *Silk Textile.* This is one of the oldest industries in J & K. It involves the production of raw silk and silk fabrics.

Silkworms are raised on mulberry leaves. Department of Sericulture distributes eggs free of cost among the silkworm rearers. About 38,500 households (in 1981-82) were engaged in the rearing of silk-worms and production of cocoons. The cocoons are purchased by the department. The total quantity of cocoons produced during the said period was 9·70 quintals—3·52 and 6·18 thousand quintals respectively in Jammu and Kashmir.

The cocoons are processed at the two filatures, one each at Srinagar and Jammu. Here silk thread is obtained from the cocoons. The quantity of raw silk produced at these two units was 52,890 kg.

The raw silk is utilised for the production of such silk fabrics as chinon, shiffon, ozeria, crepe, satin etc. at Silk Weaving Factory, Rajbagh and into silk tabby and suiting material at Handloom Silk Weaving Factory, Srinagar.

There are in all four units concerned with silk textile, one in Jammu and three in Srinagar. 1625 workers are engaged in the production of raw silk, and 606 in silk fabric manufactures. The value of production was Rs. 249 lakhs and Rs. 128 lakhs respectively.

(*v*) *Woollen Textile.* Two wollen textile factories one each at Karan Nagar and Bemina, in Srinagar produce woollen fabrics. The third unit at Naushehra in Srinagar manufactures raffle yarn. Woollen hoisery goods are produced by a unit in Jammu city. The number of workers engaged in woollen textile in all the four units is 796 and the value of manufactures was Rs. 209 lakhs in 1981-82.

(*vi*) *Wood Based Industries.* The timber obtained from the deodar and pine forests of J & K is partly utilised for the manufacture of joinery articles like doors, windows, beams, panelling and ceiling material and furniture at the two Joinery Mills one each at Pampore, Kashmir and Bari Brahmnan, Jammu. Cricket bats are manufactured

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out of Sandow wood at a factory in Miransahib Jammu. One unit produces plyboard. Total number of workers in these wood based industries is 838 and the annual production has been Rs. 190 lakhs.

(*vii*) *Cement Manufacture.* A plant for the manufacture of cement at Wuyan in Kashmir went into production in 1962. About 200 workers are employed here.

A modern cement factory capable of manufacturing 600 tons of cement per day has been set up at Khrew some distance to the east of Wuyan. The J & K Cements Ltd. Khrew on full production will ease the shortage of cement in J & K and meet its increasing demand. It employs 500 workers.

(*viii*) *Mineral Based Industries.* In this group are included Brick and Tile factory at Pampore and Liqnite Briquetting Plant as Shalateng, both in Kashmir.

There are two units engaged in the production of RCC poles, spun pipes and fence posts. One is at Wuyan and the other at Bari Brahmnan.

(*ix*) *Drug Research Laboratories.* It has two units one each at Srinagar and Jammu. These manufacture number of drugs from the medicinal herbs collected from the forests of Kashmir or raised in various drug farms.

JOINT SECTOR

(*i*) *J & K Ceramics, Kathua.* The factory was established for the manufacture of items of crockery, sanitary ware and electric insulators. It was a joint venture of J & K Government and M/s Sahu Jain Ltd.

(*ii*) *J & K Cigarettes Ltd, Bari Brahmnan.* It is a joint venture of SIDCO and Golden Tobbaco company of India.

PRIVATE SECTOR

(*i*) *Chenab Textiles, Kathua.* It is a Birla concern which manufactures staple and other synthetic fibres.

(*ii*) *Kashmir Spinning Mills, Naushehra.* This factory in private sector is engaged in the spinning of wool and raffle yarn and the production of rafal fabric.

(*iii*) *Paints and Chemicals.* There are two units manufacturing paints and allied chemicals in J & K. K.C. Paints is located at Jammu and Bharat Paints and Chemicals at Zainakot, Kashmir.

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Industrial Comlexes

J & K State Industrial Development Corporation has established industrial complexes at Rangreth, Khunmoh and Doabgah in Kashmir and at Bari Brahmnan in Jammu.

At Rangreth, the units set up assemble or produce TV sets, radios, electronic clocks, stabilizers, electric blankets, tape recorders and Jewels for watches. In Khonamoh the manufactures include joinery articles, matches, oxygen, automobile batteries, tiles and woven sacks.

Bari Brahmnan, because of its ideal location, is fast coming up as a huge industrial complex. Number of factories have gone into production, while more are coming up. The goods produced are and will be detergents, resin products, vanaspati, steel re-rolling products, scooters, floor, textiles, gypsum wall board, paper and pistons.

Small Scale Industries

There has been a remarkable increase in the number of small scale industrial units in J & K. They are spread all over the state. These units manufacture a large range of products like food, beverages, hoisery and garments, electrical goods, machinery and parts, metal, wood, leather, rubber and plastic goods, chemicals, drugs, paper-products and printing, transport equipment and finally servicing and repairing. Below is given regionwise distribution of these units.

Distribution of small Scale Units (1981—82)

Kashmir	Jammu	Ladakh	J & K
5,584	4,999	209	10,792

Handicrafts

In recent years training centres have been set up by the central and state governments for training young girls and boys in the traditional arts and crafts. As a result there has been a wide dispersal of handi-crafts throughout the state. Each distinct is involved with some handicraft. Employment to the tune of 1·5 lakh was generated in the handicraft sector during 1981-82. The value of production for the same period was Rs. 68·54 crores out of which goodsworth Rs. 36.20 crores were exported.

The handicrafts of Kashmir include the making of carpets, namdas, gabbas, woood carving and paper machine articles, embroidery—sozni, zari, leather, crewel work, wicker work, metal ware and tapestry. The handicrafts of Jammu include knitting, rubber crafts straw work

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palm leaf, and chickory wood work. In Ladakh region 265 persons were engaged in handicrafts like knitting, leather embroidery, silver ware etc. The total number of persons in handicrafts sector in 1978—79 is given below :—

Kashmir	Jammu	Ladakh	Total
91,676	6,049	265	97,990

Handlooms

The total number of persons working in the handloom sector in 1978—79 was 17,569. The handloom products include lois, puttos, tweeds, blankets, raffal, pashmina silk, dusuti and khadi. In addition, two projects one at pampore and the other at samba for handloom development have been completed.

Khadi & Village Industries

The important village industries registered with the KVI Board are leather processing and goods, oil pressing, pottery, blacksmithy, carpentry, bee keeping, paper machine, wicher work, soap making, fruit preservation, gur and khandsari. In 1981-82 16, 435 persons were engaged in these village industries. The value of production was Rs. 725 lakhs.

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10

TOURISM

Tourism happens to be a major industry in our state for it provides employment to several lakh people both directly and indirectly. Those directly involved in the industry are transporters, hotel and house boat owners and employees, guides, porters, ponymen, boatmen, travel agents, dealers in Kashmir handicrafts and a host of other workers. The workers engaged in household industries producing Kashmir handicrafts depend indirectly on tourists. Necessary facilities exist in the state for the tourists both in private and the public sector. The tourist influx has shown an upward trend during last decade as is revealed by the following table. Out of every ten tourists entering our state nine are tourists from other parts of the country and one is a foreigner.

(000 persons)

Year	Tourists Total	Domestic	Foreign
1975	1,84	1,62	22·2
1976	3,32	2,92	40·5
1977	4,42	3,87	54·2
1978	5,02	4,43	59·3
1979	5,53	4,98	55·6
1980	5,94	5,48	46·0
1981	6,42	5,98	43·7
1982	6,03	5,60	42·8

Tourism is a world wide phenomenon. Lakhs of people are continually on the move from one part of the world to the other. They move about for a number of reasons. Let us see what our state has to offer to a tourist.

(*i*) *Salubrious Climate.* Most of the tourists enter our state during summer when it is extremely hot in rest of the country. People living

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in tropical and sub-tropical India want to escape the dry heat of In summer. They seek this change in the high Himalayas. Kashmir, other Himalayan hill stations becomes their destination. The tempe and salubrious climate of Kashmir provides welcome relief to th During the rainy season other hill stations are under the influenc south west Monsoon. The skies there are generally overcast and showers quite frequent. These do not permit outdoor activities. monsoon is much less active in Kashmir and the rain quite infrequ at this time. Autumn in Kashmir is the season of maturing sun, w fruit are ripe and climate invigorating. In winter it is the snowfall the winter sports at Gulmarg that attracts the tourists. Every sea has something new to offer to a visitor to this place. Tourism, n is a year round activity in Kashmir, but the number of tour that visit the Valley is different in different seasons.

(*ii*) *Scenery*. Situated as it is within the majestic Himalay Kashmir is unsurpassed in its scenic charm. Here we have a gr variety of physical features and in a most surprising combinatio Here there are towering mountains, snow clad peaks, glaciers, sw flowing mountain streams, sparkling lakes, springs, meadows, for covered slopes and a vast plain. On account of its natural cha and bracing climate it has been often called *paradise on the ear* The biotic community is equally bewitching. There is a wide varie of trees, plants, flowers, birds and wild life. A visitor finds ample a varied scenic splendor to feast his eyes upon. He is fascinated by t loud roar of the Lidder, at Pahalgam and the undisturbed calm Gulmarg, the thick pine finests of Yusmarg and the hanging glacie of Sonamarg, the vast expanse of the Dal and the great depth of t Mansbal. Kashmir should not be considered as a single hill statio It, in fact, comprises series of hill stations, diverse and distinct, s within a single frame.

(*iii*) *Sport*. Kashmir offers variety of sport to people of differen age and temperament. They can go for sight-seeing in a moto vehicle or a *shikara*, on foot or on horse-back. They can trek o ride to meadows, tarns, glaciers and snow covered peaks. In the Da and the Nagin facilities are available for water sport like diving, swimming, water skating and boating. The cold water streams issuing from the mountains abound in trout fish. These provide excellent sport to anglers. People interested in shooting, of course with a camera,

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ave a wide range of subjects available. There are some excellent olf-courses where tournaments are held regularly. In winter Gulmarg the venue of winter sport. Some of the finest sking slopes of the orld are available here.

Some people come to Kashmir for relaxation, for mental peace nd physical well-being. They rest on the deck of a house boat in the al or on the verandah of a tourist hut at Gulmarg in calm and uiet surroundings. The cool bracing weather, the ever-changing rospect and the orchard fresh juicy fruit infuses fresh energy in heir wearied body and spirit.

(*iv*) *Pilgrimage*. There are number of pilgrim centres in J & K out the two that deserve special mention are *Shri Vaishno Devi* in Jammu Province and *Shri Amar Nath Ji* in Kashmir province. Both are visited by pilgrims drawn from far off place. In case of the former a regular stream of pilgrims keeps on pouring throughout the year, while pilgrimage to the latter is held once in a year. Both pilgrim centres are associated with caves in limestone ridges.

The temple of Shri Vaishno Devi is situated in a cave at a height of 1560 m a/s.l. in the Trikuta mountain. From Jammu city the pilgrims travel by road upto Katra, which lies 50 km to the north of the former. A 12-km trek to the holy cave begins from Katra. During recent times these has been a phenomenal increase in the number of pilgrims as is revealed by the following :—

Pilgrims to Shri Vaishno Devi (in thousands)

1977	815	1981	1213
1978	881	1982	1189
1979	1124		
1980	1212		

The holy cave of *Shri Amar Nath Ji* is situated in the north eastern corner of Kashmir, in the head water region of the Sindh and the Lidder. A colossal cave exists here which is skirted by Amravati stream. In it the self-formed ice lingam is the object of worship.

The pilgrimage takes place on *Sravana Poornima*, in July-August. Trek to the cave begins from Pahalgam. The 45 km. long trek is covered in three days. The pilgrims pass through the high Himalayas, which in this past of Kashmir are fascinating and majestic. The cave is situated at an amplitude of 3880 m and the highest spot enroute

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is Mahagunas, top with an elevation of 4265 m. The number of pilgr to the holy cave is given below :

Pilgrims to Shri Amar Nath Ji (in thousands)

1977	12·2	1981	26·0
1978	19·7	1982	25·0
1979	16·7		
1980	19·5		

(*v*) *Places of Historical Interest.* Kashmir had a long and chequered history. The records of its history lie strewn over length and breadth in the form of ancient monuments, impres structures and magnificient gardens. The evidences of ancient g of Kashmir stand in the form of temple ruins at Martand, Awantip Wangat, Paraspore, Buniyar and other places. In the mediaeval pe Kashmir had excelled in the field of wooden architecture. specimens of this architecture are available in the form of Khanq and mosques. The Jama Masjid, Khanqahs of Amir-i-Kabir Naqashband Sahib, the Ziarats of Sheikh Nur-ud-Din, Sheikh Ha Makhdoom and Dastigir Sahib and the Imambara at Zadibal are outstanding examples of Kashmiri Wooden architecture. Moghuls brought with them the special style of landscape architect In Kashmir they found ideal conditions for garden laying. Mog gardens in their pristine glory are Shalimar, Nishat, Cheshma Sh and Acchabal. The other historical sites are the Dargah at Hazrat and the Gurudwara Chattipadshahi.

(*vi*) *Research Studies.* Teams of scholars and students ar in Kashmir from other parts of the country and from abroad carry out research in their respective disciplines. Kashmir offers a field of study for a botamist and zoologist, geologist and geograph archaeologist and a historian and the like.

(*vii*) *Handicrafts.* Kashmir handicrafts adorn the drawing roo of the people spread over almost all the continents of the world. deft fingers and skilled hands of a Kashmiri craftsmen produce variety of goods which visitors like to carry with them as momen of their visit to the Happy Valley. These handicrafts include wo carving, paper machie, carpets, namdas, crewel work, wicker wo metal ware, cut-stonies and embroidery.

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Places of Tourist Interest

(*a*) *Kashmir.* Tourists to Kashmir arrive in Srinagar either by road or by air. From Srinagar they spread out to various scenic spots. While in Srinagar they visit the Moghul gardens and enjoy a *Shikara* ride in the Dal or down the river. Some of them stay in a house boat that is moored either in the Dal or the Nigeen.

Outside Srinagar the lakes which are worth a visit are Mansbal and Wular. They also visit Pahalgam, Sonamarg and Daksum in the Himalayas, Gulmarg, Yusmarg and Ahrabal on the slopes of the Pir Panjal range.

Pahalgam lies in the Lidder Valley at a distance of 96 km to the east of Srinagar. It stands at an altitude of 2134 m. The mountain slopes are covered with forests of blue pine and silver fir. Pahalgam becomes a base camp for a series of treks to such places as Kolahoi glacier, Tarsar lake, Sheshnag, Shri Amar Nath cave, Tulin and Baisaran.

Gulmarg, the meadow of flowers, has an elevation of 2653 m. It lies to the west of Srinagar at a distance of 50 km. From Gulmarg one can go to Khillanmarg, Apharwat, Alpather, Ningle nallah and Baba Rishi.

The famous springs of Mattan, Anantnag, Acchabal, Kokernag and Verinag are located in South Kashmir.

(*b*) *Jammu.* The scenic spots of Jammu province are situated mostly in the *Pahar region.* These are Bhaderwah, Batote, Kud and Kishtiwar. In recent years tourist sites and complexes have been established at places like Jaijar Kotli, Patni Top, Sanasar and the lakes Mansar and Saruinsar.

Jajjar Kotli lies on the National Highway in the Siwalik hills, on the left bank of a Shallow but sparkling stream.

Patni Top has a elevation of 2060 m. The tourist huts are located in the midst of a pine forests. It has become a nucleus of a tourist complex which includes Kud, Batote, Sanasar and Sudh Mahadev.

Sanasar is a forest girdled meadow situated at a distance of 8 km. from Patni Top. It has an altitude of 2100 m.

The Mansar and the Saruinsar are the two Siwalik lakes situated to the east of Jammu.

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Bhaderwah resembles Kashmir in a number of respects particularly terrain, climate and vegetation. It is an excellent scenic spot. From Bhaderwah number of picturesque places can be visited. These are Jayi, Bhles, Chinta and Bal Padri. A bi-yearly pilgrimmage from Bhaderwah takes place to Kaplash Kund a tarn situated, in the Middle Mountains, close to the source of the Tawi.

(*c*) *Ladakh.* The dry, dreary, desolate and dusty landscape of Ladakh has given it, the name of 'Moonland'. It has been opened to tourist traffic recently. It is being visited mostly by the foreigners. They are fascinated by the culture of this trans-Himalayan region as much as they are by its physical features. The star attractions of the cultural landscape of this region are the *Gompas* or the monastries which are the repositories of Budhist (Mahayan) literature, precious treasures, Budha images, tanakas and the like. Tourists participate in the annual fair of Hemis Gompa, the largest and the chief monastery of North-Western India.

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11
POPULATION

Compared with the total geographical area of J & K the population figures of 59·5 lakhs (1981) are not seemingly too high. An entirely different picture emerges when we consider the mountainous terrain, severe climate and other environmental constraints of this state. Against that vast geographical area the total cropped are is just 22·4 lakh acres. It is said that it takes the production of a little over one acre of cropped land plus the animal products of open grazing land and the products of the forests to support one 'average' human being. With this as the yardstick it is left to the reader to draw his own conclusions regarding the land-man ratio in our state. At the same time he can evaluate the degree and extent to which this state is overpopulated.

GROWTH. The growth of population in J & K since the beginning of this century upto the latest census presents an interesting study. Two marked trends are discernible. The decade, 1951-61, serves as a divide. During the first four decades there has been a marginal growth of population. With the base of 21·3 lakh persons in 1901 the population increased by 1·6 lakhs during 1901-11, 1·8 lakhs during 1911-21, 2·0 lakhs during 1921-31, and 2·7 lakhs during 1931-41. There has been a steady increase of population during the first four decades and the maximum increase was 2·7 lakhs only.

J & K—Growth of Population—lakh Persons

Census Year	Total Population		Increase in Pop.	%increase in Pop.
1901	21·3		...	...
1911	22·9		1·6	7·5
1921	24·7		1·8	7·8
1931	26·7		2·0	8·1
1941	29·4		2·7	10·1
1951	32·5	(Estimated)	...	...
1961	35·6		...	...
1971	46·1		10·5	29·60
1981	59·5		13·4	28·97
1991	76·0	(Projected)	...	...
2001	100·0	(,,)	...	...

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The reasons for this nominal growth, of 7·5%. 7·8%, 8·1% and 10·1%, are well known to deserve a detailed treatment. Mass poverty illiteracy, supersititions, lack of medical facilities, epidemics, high birth rate, high rate of infantile mortality, high death rate and the like were the factors which kept the population in check.

1947 witnessed the partition of the sub-continent into two dominions and large scale transfer of population. The Pak Invasion of Oct. 1947 saw the illegal occupation of about one third area of the state. No census could be conducted in the year 1951. But the population was estimated to be 32·5 lakh persons. Though a sizeable area was lost, the population did not decrease. On the contrary it continued to increase. The next census was held in 1961 when the population of the state on this side of the Line of Actual Control rose to 35·6 lakhs.

The period that followed may be termed as the second phase in which there has been a phenomenal growth of population. The decennial population growth rate for 1961-71 was 29·60%. It was 28·17% during the decade 1971-81. In 1971 the population of the state was more than double of the population of 1901. The population in 1981 was double than that of the population in 1941.

This unprecedented increase in population can partly be attributed to the era of economic and social well-being ushered in India with the launching of Five Year Plans since 1951. During each plan huge funds were allocated for the development of agriculture, irrigation, power, industry, education, health and social welfare. Consequently the death rate decreased and so did the rate of infantile mortality. The net result was a great increase in population.

If population continues to increase at the present rate, it is expected that the population of J & K in 1991 shall be 76 lakhs. It will be one crore in 2001. Can our developmental programmes keep pace with this increasing population ?

In the following pages some attributes of the population of J & K shall be discussed.

(i) Distribution

The total number of districts in our state is fourteen. The provinces of Kashmir and Jammu, consist of six districts each. There are only two districts in Ladakh region. The regions of J & K in order of their area are Ladakh, Jammu and Kashmir. The order is almost reversed

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as far as population is concerned. Kashmir with the least area has the highest population of 31·30 lakh. Ladakh, on the other hand, with largest area has the least population of 1·21 lakh. With a population of 26·39 lakh, Jammu holds an intermediate position with respect to area as well as population.

Jammu district has the highest population of 9·28 lakh not only in Jammu province but also in the entire J & K. It is the followed by Srinagar district where the total population is 7·21 lakh.

J & K Distribution of Population—1981

S.No.	District	Population	District	Population	District	Population
1	Srinagar	7,21,078	Jammu	9,28,638	Ladakh	0,67,733
2	Baramulla	6,69,405	Udhampur	4,52.244	Kargil	0,64,566
3	Anantnag	6,54,945	Doda	4,24,390		
4	Pulwama	4,04,351	Kathua	3,65,029		
5	Badgam	3,52,759	Rajouri	2,98,830		
6	Kupwara	3,27,552	Poonch	2,22,490		
	Kashmir Province	31,30,090	Jammu Province	26,91,621	Ladakh Region	1,32,299
	Total For J & K 59,54,010					

The two districts with a population between six and seven lakh persons are Baramulla and Anantnag, both in Kashmir province. Three districts have a population of more than four but less than five lakh persons. Two such districts, Udhampur and Doda are in Jammu province, while the third, Pulwama, is in Kashmir province. Kathua, Badgam and Kupwara are the three districts with a population between three and four lakh persons. The districts with a population of two and three lakh persons are Rajouri and Poonch. The two districts of Ladakh and Kargil have the least population of less than ·75 lakh persons.

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(ii) **Composition**

(*a*) *Rural-Urban.* Out of the total population of 59·5 lakh persons in J & K, 47 0 lakh persons live in villages. The percentage of rural population to total population is 79·0. The total number of villages is 6503. Out of this total number of villages, 3394 are in Jammu province, 2874 in Kashmir province and 235 in Ladakh region.

The total urban population is 12·5 lakh, which is 21% of the total population. This proportion of Urban population is less than the national average of 23·71%. There are fifty eight urban centres including urban agglomerations which are distributed as under.

Towns	Jammu	Kashmir	Ladakh
Class I [100,000 and above]	one*	one*	nil
Class II [50,000 to 99,999]	nil	nil	nil
Class III [20,000 to 49,999]	2	3	nil
Class IV [10,000 to 19,999]	2	3	nil
Class V [5,000 to 9,999]	9	9	1
Class VI [less than 5000]	17	7	1
Total	31	23	2

*The urban agglomeration of Srinagar includes Srinagar city and Badamibagh cantonment. The Jammu U.A. includes Jammu City and Jammu cantonment. The total population of these urban agglomerations of Srinagar and Jammu is 6·04 and 2·19 lakh respectively.

Of all the districts of J & K, Jammu district has the highest population of 9·2 lakh, out of which 6·5 lakh persons live in 1063 villages. Jammu district stands number one in total rural population as well as in the total number of villages. The urban population occupies one city and eight urban centres. It holds first position in the number of urban centres.

On the other hand in Srinagar district 6·04 lakh persons out of a total population of 7·21 lakh live in one city and two urban centres. Srinagar district holds first position in urban population.

(*b*) *Sex Ratio and Literacy.* Sex ratio of the population is expressed in terms of number of females per thousand males. In J & K for every thousand males the total number of females is 899. This indicates a preponderance of males in the sex composition of population in J & K.

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S. No.	District	No of females per 1,000 males	Percentage of Literates	District	No of females per 1000 males	% of Literates	District	No of females per 1000 males	% of Literates
1	Anantnag	889	22·6	Doda	909	18·2	Kargil	897	17·0
2	Pulwama	897	19·9	Udhampur	912	23·5	Ladakh	902	24·1
3	Srinagar	873	33·7	Kathua	926	31·4			
4	Badgam	884	16·4	Jammu	941	43·0			
5	Baramulla	872	19·5	Rajouri	923	23·6			
6	Kupwara	860	16·0	Poonch	903	22·1			

The districtwise distribution presents an interesting pattern. Taking state average as thc basis, seven districts have a higher and the other seven a lower sex ratio. All the districts of Jammu province plus the Ladakh district have a higher sex ratio than the state average. In each case it exceeds 902. Contrary to it all the districts of Kashmir province and also Kargil district have a sex ratio below 899. Jammu district leads with the highest sex ratio of 943, whereas Kapwara district has the least figures of 860.

The number of literate persons in the population of J & K presents a dismal picture particularly in view of the fact that education, in this state, is free from primary to university level. The rapid and wide expansion of educational facilities have, it appears, proved ineffective. For the entire state the literacy rate is only 26·17%. It is higher viz. 35·49% in case of males and lower, viz. 15·82%, in case of females. It is more in case of urban and less in case of rural population. The districtwise distribution of literacy is far from uniform. Three districts have a higher percentage of literates, higher than the state average. These are Srinagar, Kathua and Jammu. It is less than the state average for rest of the eleven districts. Badgam and Kupwara have the least literacy percentage of 16·5 and 16·0 respectively, Jammu district has the highest literacy percentage of 43·0.

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(*c*) *Occupations*. The work force during 1981 census, has been listed under three heads—main workers, marginal workers and non-workers. A worker has been defined as a person who had done any economically productive work during the last one year preceding the date of enumeration. He is a *main worker* if he works for a major part of the year viz. 6 months or 183 days or more ; *marginal worker* if he has worked for less than six months ; and *non-worker* if he does not participate in any economically productive work. The percentage of these three groups of workers was 30·0 ; 13·4 and 56·6 respectively. If we group together main workers and marginal workers wo observe that the proportion of non-workers is still higher. In other words less than half of the population is economically productive. Non-workers in the population include students. dependents, retired persons, beggars, persons engaged in household duties, inmates of institutions and other non-workers.

Workers are also divided into four categories according to their occupations or means of earning a living. These are cultivators, agricultural labour, workers employed in household industries and other workers. The composition of the population in J & K according to their economic activities is as under.

(*a*)	Cultivators	—57·8%
(*b*)	Agricultural labour	— 3·7%
(*c*)	Household industry	— 5·6%
(*d*)	Other Workers	—32·9%

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PART—II

ESSAYS GEOGRAPHICAL

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12

SPACE RELATIONSHIPS

Space relationships are basic geographic factors. These include shape, size and location. Each of these have definite part to play in the development of a place, a region or a nation. Through location we know where a particular thing is on the surface of the earth. In geography location is the first thing we want to know in the study of a particular area, phenomenon or process. In it we find the answer to the question : *Where is it* ?

Location.

Location can be *absolute* or *relative*. The *absolute location* of a place is expressed in terms of degrees of latitude and longitude. The point of intersection of parallels of latitude and meridians of longitude gives the exact location of a place on the globe. Coordinates of this point with reference to equator and prime meridian give its absolute location. The absolute location of Srinagar, for example, is 34° 5′ N and 74° 46′ E. Srinagar is located in, the northern hemisphere, 34° 5′ north of equator and 74° 46′ east of prime meridian.

Relative location is often identified with situation or geographical position. In it, through a statement, the location of a place is expressed with reference to other known features, both natural and cultural, of the landscape Srinagar is situated in the middle of the valley floor on either banks of the Vyeth (the Jhelum) in Kashmir.

The former presents the mathematical and precise position of Srinagar on the earth while the latter gives us an insight into the position of Srinagar in Kashmir Valley. It aids us to get a peep into the geographical personality of Srinagar. In geography both the procedures are essential and desirable.

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On a map is observed a network of two sets of lines which intersect each other. The horizontal lines, in this network, correspond to the *parallels of latitude* and the vertical to *meridians of longitude*. It is quite easy to draw such a network of horizontal and vertical lines on a plane surface but all the more difficult on a spherical surface. This is due to the absence of suitable reference points on a sphere.

This difficulty can be apprehended when we take a table tennis ball and put an ink dot on it. Locate the position of the dot on this ball. We, almost, fail to do so for we do not know where to begin and where to end. This explains the fact that we do not have any fixed points on a sphere which could be referred to while locating a place on it.

This problem of the absence of reference points on the near spherical surface of the earth has been solved in an interesting manner. Here clue has been taken from the fact of rotation of the earth. We know that our planet spins on its imaginary axis once in twenty four hours. The end points of this imaginary axis constitute the two poles of the earth. Thus the north pole and the south pole are the two fixed points for the convenient drawing of the network of parallels and meridians. [It needs to be remembered that parallels of latitude and meridians of longitude are imaginary lines, which are drawn on a globe or a map, but not found on the earth.]

Parallels of Latitude.

On a globe draw a circle at half the distance from the poles. This circle divides the globe into two halves. Each half is the northern and the southern hemisphere. This equating circle is called the *equator*.

Circles drawn on the globe, to the north and south of and parallel to the equator, at equal intervals, are *parallels of latitude*.

All parallels of latitude are complete circles. Equator is the largest circle. The radius of all other parallels diminishes as we proceed north and south of the equator. The pole is only a point. Viewed from above the parallels appear as concentric circles of diminishing radii with pole as the centre.

Latitude may be distinguished from a parallel of latitude. Latitude of a place is the angular distance on the earth surface, north and south of the equator, as measured from the centre of the earth.

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An angular distance of one right angle or ninety degrees is to be traversed as we move from equator to either pole. The total number of the degrees of latitude on either side of the equator is ninety. The latitude of equator is zero degree and that of north pole and south pole is 90° N and 90° S respectively. All other parallels are numbered degrees north or degrees south. At one degree interval we have ninety parallels to the north of the equator and ninety degrees to its south. The total number of parallels is 181.

Important Parallels.

The rotation of the earth has played a pivotal role in fixing the two poles, the equator and the parallels of latitude on the globe. The inclination of the axis of the earth has played an equally significant part in fixing the important parallels like the *tropics*, 23½ degrees away from the equator and *polar circles*, 23½ degrees away from the poles.

(*i*) *Equator*. It the zero degree latitute. All points on the equator are equidistant from the poles. It is a great circle. Its plane passes through the centre of the earth. Since this is the initial parallel of latitude all distances are reckoned north and south of it. The sun shines vertically over it twice in a year on March 21, and Sept. 23 i.e. *on equinoxes*.

(*ii*) *Tropic of cancer*. Is the parallel of 23½° N. The sun's rays are vertical over the tropic of cancer, once in a year, on the day of summer solstice in the northern hemisphere i.e. June 21. It marks the northern limit where the sun appears to shine vertically at noon.

(*iii*) *Tropic of capricorn*. It is the parallel of 23½° S. This indicates the southern limit where the sun appears to shine directly overhead at noon. On summer solstic of the southern hemisphere viz. December 22, the sun ray's shine vertically over it.

(*iv*) *Polar circles*. Arctic circle and Antarctic circle is the name given to the parallels of 66½° N and 66½° S, respectively. The sun does not set (or rise) for twenty four hours, once in a year, on polar circles, this happens on June 21 and Dec. 22, as the case may be. Within the polar circles the number of days for which the sun does not set or rise increases as we proceed towards the poles. Hammerfest (70½° N) in Norway experiences daylight for a period of 78 days from May 13 to July 29.

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(v) *Poles.* The north pole is 90° N and the south is 90° S latitude. At the north poles the sun shines continuously for a period of six months from spring *equinox* to autumn *equinox*. It does not appear for another six months from autumn to spring *equinoxes*. The reverse is the case at the south pole.

Latitude and climate.

The climate of a particular place is the net result of a series of factors called the climatic controls. One of the most significant factors is latitude or the sun control. The amount of solar energy or *insolation* received at any place is dependent upon (i) hours of daylight and (ii) angle of the sun's rays.

(i) The duration of daylight is directly related to the latitude as is evident from the following :—

Maximum Duration of Daylight

Latitude	Duration	Latitude	Duration
0°	12-00 hrs.	50°	16-09 hrs.
10°	12-35 ,,	60°	18-30 ,,
20°	13-13 ,,	66½°	24-00 ,,
30°	13-56 ,,	70°	62 days
34° (Srinagar)	14-26 ,,	80°	134 ,,
40°	14-51 ,,	90°	6 months

These figures reveal that the maximum duration of daylight is 12 hours at the equator. The duration gradually increases as we move towards higher latitudes. It is maximum at the poles.

(ii) The rays of the sun that reach the surface of the earth are either vertical or oblique. Vertical rays are more effective in their heating power than the oblique rays. The heating power diminishes as the rays become more slanting The rays of the sun are almost vertical within the tropics while their angle of inclination decreases as we proceed away from the tropics towards the poles.

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Angle of Incidence of the Rays of the sun in the Northern Hemisphere on June 21.

S. No.	Station	Lat.	Angle	S. No.	Station	Lat.	Angle
1.	Durgapur	23½°	90°	5.	Chicago	42°	70½°
2.	Delhi	28½	85	6.	London	51½	62
3.	Jammu	32½	81	7.	Reykjavik	64	49½
4.	Srinagar	34	79½	8.	Hammerfest	70½	43

Within the tropics large amounts of solar energy are received as the sun rays fall almost vertically throughout the year. But in high latitudes only small amounts of solar energy are received because the rays are oblique.

Climatic Zones.

The total effect of the duration of daylight and the inclination of the sun's rays has resulted in the division of the globe into definite climatic belts or zones. The Greeks had divided the earth into three heat zones namely torrid, temperate and frigid, corresponding to hot, moderate and cold regions respectively. The present classification is tropical, sub-tropical, temperate and arctic.

(*i*) *Tropical.* Tropics is the name given to that part of the earth which lies between the Tropic of cancer and the Tropic of capricorn. The sun's rays within this zone are almost vertical. The weather in general, within this belt, is always hot. The tropics, except highland areas, are characterised by a continuous frost-free season. Plant growth takes place throughout the year. It is marked by a perpetual summer and an endless growing season. The belt is referred to as low latitudes. The climate is called tropical. In brief, tropical climate is warm to hot year round.

(*ii*) *Temperate.* The area between the tropics and the corresponding polar circles constitutes the temperate zone. The sun never shines vertically in this belt and obliquity of the sun varies from season to season. The region is characterised by definite warm and cool seasons as by summer and winter. Not all areas in this zone enjoy temperate

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climate. The exceptions are in the continental interiors and along eastern margins of the continents in the northern hemisphere. The region is also referred to as middle latitudes or intermediate zone. Temperate climate stands for cold winter, hot summer with spring and fall seasons.

(*iii*) *Sub-Tropics*. The transition from tropical to temperate climate is not abrupt but gradual. There is a zone of hot summers and mild winters between the tropics and temperate region. This is called sub-tropics. It roughly lies between 25° and 40° latitudes.

(*iv*) *Arctic*. This zone lies within the polar circles. The sun's rays are always very oblique. The weather in general is never warm. It is cool or cold in summer and extremely cold in winter. It is characterised by perpetual frost. Arctic or polar climate is identified with long cold winters and short cool summers.

Meridians of Longitude

In the network formed by the intersection of the parallels of latitude and meridians of longitude, the former run in east-west and the latter in north-south direction.

Lines of longitude are semi-circles which run from north pole to south pole and cut the equator at right angles. All meridians of longitude, unlike parallels of latitude, are of equal size. This presented a difficulty in fiixng a meridian from which counting could be started. Since 1884, as a result of an international agreement the meridian passing through Royal Astronomical Observatory at Greenwich, near London, has been accepted as the prime meridian. The prime meridian or Greenwich meridian is the zero degree longitude. Meridians are reckoned, in degrees, to the east and west of Greenwich from 0° to 180°. Only the 180°E and 180°W is the same meridian. The great circle formed by tha zero degree and 180° meridian divides the earth into two hemispheres the eastern and the western.

Longitude, like latitude, is the angular distance. Longitude of a place is the angle made by the plane of its meridian with the plane of the prime meridian at the axis of the earth. As the sum of the angles at the centre of the earth along the plane of equator is 360°, the total number of merdians is 360°.

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The distance between one degree longitude or one degree latitude along the equator is 110 km.

Longitude and Time

Longitude along with latitude give the absolute location of a place. Besides, longitude is intimately connected with time. If parallels of latitude are the climatic lines the meridians of longitude are, undoubtedly, the time lines.

Two basic facts need to be appreciated while establishing a link between the longitude of a place and its time. Both are concerned with the rotation of the earth. One with the period of rotation, another with its direction. The earth completes one spin on its axis in twenty four hours and the direction of the spin is from west to east. Consequently when one part of the earth is in the zone of illumination the area exactly opposite to it is in the zone of darkness. Also the sun appears to move from east to west so that rising sun appears later and later at places more and more to the west. This difference in time in different parts of the earth is illustrated with help of the following example. When it is I P.M (Greenwich Mean Time) at Japan, it is 5-30 PM in Allahabad, 12 noon at Greenwich, 7 A.M. at New York and 4 A.M. at San Fransisco.

As the earth rotates all the 360 meridians move before the sun in twenty four hours. In this way 4 minutes of time ($24 \times 60 \div 360$) correspond to 1° of rotation. Further places lying to the east of Greewich have time ahead of the latter and those lying to its west have time behind it.

Before we proceed further it is desirable to distinguish between local time and standard time.

Local time of a particular place is the time calculated from the position of the sun at that place. When the meridian of a place is exactly in front of the sun, it is noon at that place. At this time the sun is at a highest position in the sky. The shadow cast by the sun at this time is shortest. The local time of several places on the same meridian will be same, while local time of several places on different meridians shall be different. Sundial is used to know the local time of a place.

Standard Time. In order to have uniform time in one country or a zone the meridian of a centrally located place is selected as the standard meridian. The local time of this standard meridian is used as the time for the entire country or zone. While selecting a standard meridian

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care is taken to see that it is divisible by 15° or 7½°. It is done to see that the time difference with G.M.T. is a multiple of an hour or half an hour.

The standard meridian of India is 82½°E. It runs close to Allahabad. The standard time of India (I.S.T.) is 5½ hours ahead of G.M.T.

Countries with a large east-west extent have not one but several standard time zones. In U.S.S.R. the number of time zones is eleven end in U.S.A. seven.

Time from midnight to noon is expressed in terms of a.m. (*ante-meridian*) or fore noon and from noon to midnight as p.m. (*post-meridian*) or after noon. There is yet another way of expressing time. For example 4-15 P.M. can be expressed as 1615 hrs. and 5-35 A.M. as 0435 hrs.

Calculation of Time

Three steps are involved in finding time with the help of longitudes.

(*a*) Find the difference in longitude between the two places.

(*b*) Knowing that 1° difference in longitude equals 4 minutes of time, find out the difference in time between two places by multiplying difference in longitude by four minutes.

(*c*) Add to or subtract from the known time the time difference calculated in (*b*) above, as the case may be.

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13

REALMS OF THE EARTH

Our earth consists of a solid, a liquid and a gaseous part. These distinct areas (the *lithosphere* (rock sphere), *hydrosphere* (water sphere) and *atmosphere* (gas sphere) constitute the three realms or domains of the earth. These realms are present in the form of concentric spheres. The hydrosphere rests on the lithosphere, while both are surrounded by atmosphere.

LITHOSPHERE

Lithosphere is name, generally, given to the solid crust of the earth that surrounds its metallic core. The surface of the lithosphere is marked by broad corrugations ; the large higher portions form continents and the vast low lying parts form ocean basins. The total area under continents and scattered islands is about 22·2% of the total area of the earth's surface, the rest being under oceans.

The continents and oceans constitute the land forms of the first order. Both are made up of rocks. As a rule, the continents are made up of lighter rocks rich in silica and aluminium (*sial*) and are similar in composition to granite. The rocks that lie underneath oceans as well as continents are denser rocks and abound in silica and magnesium (*sima*). These rocks are similar in composition to basalt. In this way the light continental rocks rest on comparatively heavier rocks of ocean basins.

Rocks in turn are made up of certain basic minerals like quartz, felspars, mica, hornblende and calcite. Rocks and minerals are the foundation materials of the lithosphere.

The solid part of the lithosphere is termed as *bed rock*. At certain places it is covered by a pile of loose malerical, of varying thickness. It is either derived from the bed rock or transported to its present position by wind, ice or water. It is called *mantle rock* or *soil*. Bed rock has

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profound influence on terrain, nature of soil, availability of sub-soil water, drainage and distribution of minerals.

Continents

The entire human population lives on the land surface of the earth. It is the land that provides him the soil to raise crops and the minerals to run his factories. It is here that he has built his home and hearth.

The land surface of the earth is divided into large unbroken masses called *continents*. The average thickness of the continental masses is 35 km. Mt. Everest, with an altitude of 8·84 km, is the highest spot on the land surface.

The continents, in order of their size, are Asia, Africa, North America, South America, Antarctica, Europe and Australia. Eurasia is a single land mass which has been divided into two parts. The eastern part is Asia (*the East* or *the Orient*) and the Western is Europe (*the West or the Occident*). Both of these continents lie completely in the northern hemisphere. Africa stretches through both the hemispheres—northern and southern. North America lies completely in the northern hemisphere, while major portion of South America lies in the southern hemisphere. These continents together are called Americas and are separated by the Panama Canal. Australia and Antarctica are situated in the southern hemispere. Antarctica is the southern most continent. There is more land in the northern than in the southern hemisphere. Asia is the largest and Australia the smallest continent. Antarctica surrounds the south pole. It is an ice bound continent and does not support any human population.

Major Landforms

The land surface of the earth is not even everywhere. It shows marked diversity in its relief or physical features. On it are found plains and plateaus, hills and mountains. These four features constitute the major land forms of the earth. They are also called the landforms of second order. Major landforms give rose to an endless variety of minor features.

Significance. Major landforms play a significant role in the distribution of population. Most of the population of the world in concentrated in the great river plains. Such plains have been productive agricultural areas. In certain parts of tropics plateaus afford suitable sights

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for human settlements. Low hills with a soil cover have been used and occupied by man. He has always avoided mountains, as far as possible, on account of their great height and sloping terrain. The relationship between major landforms and man has been summed up by Miss Ellen C. Semple in the following words, "Mountains tend to repel the development of large and wide spread population centres. Man like air and water feels always the pull of gravity. He prefers the plains and it is only with increased effort and often with deprivations that settlements in high lands have been possible." The nature and extent of major landforms in a country determine its land resources.

(i) *Plains.* These are areas of low elevation with an altitude of less than 150 m. They are characterised by a smooth or slightly rolling surface. They are also designated as *low lands*.

The two common types of plains, based on their location, are *coastal* plains and *interior* plains. The Eastern and The Western Coastal Plains of India skirt the Bay of Bengal and the Arabian Sea respectively. The Ganga Plain or the Sutlej Plain are the examples of interior plains. Depending on its mode of formation it can be an *erosional* or a *depositional* plain. The former is the result of erosion of a hill or a plateau. The West Siberian Plain is an example of erosional plain. When it is formed by the filling up of depressions by the deposition of eroded material, it is a depositional plain. It is an *alluvial* plain, like the Ganga-Sutlej Plain, when the sediment is deposited by a river. *Loess* plains and *drift* plains are formed when the deposition is the result of such agencies wind and moving ice respectively. The Karewas of Kashmir consists of the materials deposited in the pre-historic lake of *Satisara* by streams, glaciers and wind.

The great alluvial plains of the world are densely populated. About two thirds of the world population lives there. Their fertile soils, a shallow water table, and easily available irrigation facilities have lead to their agricultural productivity. In hot regions more than one crop is raised from the same patch of land. Building of roads, railway lines, canals and airports too is easy. Industries based on agricultural or other raw materials thrive in these plains, which besides providing cheap labour serve as a ready market for the manufactured products.

(ii) *Plateaus.* Like a plain it is characterised by a smooth or somewhat rolling surface. It is differentiated from the plain by its

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elevation. By virtue of its altitude a plateau stands out conspicuously in comparison to surrounding areas. It is called an *upland*, when it is close to or surrounded by a plain. It is a *tableland* when bounded by steep cliff like faces which lead abruptly down to the sea.

Some level surfaces at great elevations in the mountainous areas too are called plateaus. It is an *intermontane* plateau when it is formed in association with the mountains and is partly or completely surrounded by mountains. Plateaus of Tibet and Bolivia are the examples of intermontane plateaus. It is a *piedmont* platean when it lies between the mountains and the plains or sea *e.g.* the plateau of Patagonia in South America. When it rises abruptly from the sea or lowlands it is *continental* plateau *e.g.* plateau of South Africa, Chota Nagpur and Shillong plateaus. Parts of the Deccan and the Malwa plateaus are formed by the accumulation of lava which poured out through the fissures in its surface.

Most of the plateaus are arid. Man has utilised those plateaus which are rich in forest, agricultural and mineral resources. The Indian tableland is a store house of minerals. Number of industries have been established here. Parts of it like Bangalore are known for their salubrious climate.

(*iii*) *Hills*. Hills are those elevated areas where the local relief is from 160 to 600 m. Most of the area in a hill is in slopes while a part of it is in summits. Some low hills with sufficient soil cover have been occupied by man. The Siwalik hills of our state present a good example.

(*iv*) *Mountains*. These are sufficiently massive structures with an altitude exceeding 600 m. Mountains are not merely high hills. In a mountain the entire area is in slopes. The summit area of a mountain is too small in comparison to the area of its base. Mountainous regions are often designated as *highlands*.

Mountains are formed by *folding* as well as by *faulting*. Fold mountains can be both young and old. The Himalyas, the Alps, the Rockies and the Andes are the principal *young fold mountains* of the world. They were formed during the mid-Tertiary times, about 60 million years ago. The period of their formation is refered to as Alpine Orogeny. *Old fold mountains* belong to Hercynian aad Caledonian orogenies. They have lost much of their grandeur at the hands of the

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of erosion to which they were exposed for millions of years. Mountains of Scotland, Scandinavian mountains, the Urals and the Appalachians belong to this group. *Block mountains* are a result of faulting. The mountain mass is formed by the uplift of land between faults or subsidence of land outside the faults. The two good examples of block mountains are the Vosges in France and the Black Forest in Germany. *Residual* or *relict* mountains are formed by the wearing down of fold mountains, plateaus or other elevated regions. The Nilgiris and the Rajmahal mountains are the examples of such mountains. *Volcanic mountains* are formed by the accumulation of volcanic material. Mt Etna and Mt Fujisan are volcanic mountains.

Significance. Lofty mountain ranges with high inaccessible passes have acted as racial and cultural barriers between two peoples. They served as natural frontiers as well. On the other hand mountains with low altitude passes served as the doors of entry for the settlers and invaders. Mountains like the Urals are a vast repository of valuable metals Mountains which are forested and have grass cover are utilised for lumbering, grazing and gathering. It is in mountainous areas that hydro-electric projects are built. Dams are built across rivers in highlands to store water for irrigation and power-generation. They help in preventing floods in the plains. Mountains provide man with sport and recreation. Health resorts are invariably situated in highlands. But mountains are no longer invincible. They need to be defended now. It involves lot of resources and effort to maintain defence installations at staggering heights on the Himalayan borders.

HYDROSPHERE

Our earth is called a 'watery planet'. 70·8% of its surface area is covered with water, the rest being land. The oceans, seas, lakes, rivers and other water bodies make up our hydrosphere. Hydrosphere is a comparatively shallow layer of water which covers over two-thirds of the earth's surface. Through it lithosphere projects to form continents. Water exists in the solid as well as gaseous state on the earth. Large quantities of water vapour are always present in the atmosphere. Huge amounts of ice and snow are present in polar ice caps and continental glaciers.

Water, on our planet, is a physiological necessity for all forms of life. Large quantities of fresh water are needed by man today to satisfy

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the innumerable demands of modern living. He needs water for irrigation, power, industry, sanitation and recreation. Schemes for the development of an area are closely linked with the quality and quantity of available water.

Oceans. Ninety seven percent of the water present in the hydrosphere lies in the oceans, while only three percent is found overland. Oceans form one continuous and interconnected body of water. The continents look like large islands in it. The continents in fact, divide this otherwise single body of water into four oceans. These in order of their area are the Pacific, the Atlantic, the Indian and the Arctic. The percentage area of these oceans is 49·5, 24·5, 22·0 and 4·0 respectively.

Water in oceans moves both horizontally and vertically. The movement of sea water takes place in the form of *waves*, *currents* and *tides*. In each case some kind of force is needed to set the ocean water into motion. It may be wind action in case of waves end currents. Tides on the other hand are caused by the gravitational force of the moon and the sun.

Currents. An *ocean current*, according to F.J. Monk house, is the general movement of a mass of surface water in a fairly uniform direction. Several factors combine together to give rise to currents in oceans. The density of the sea water changes according to its temperature and salinity. Warm water is light and floats on the surface while cold water is dense and, sinks to the bottom. The density of water with high salinity is higher than the water with low salinity. The difference in the temperature and salinity cause movement of ocean water. Winds which blow constantly in one direction drag the surface water in the same direction, thereby causing surface currents. The direction of the currents is influenced by the rotation of the earth. The currents in the northern hemisphere move in a clockwise direction while the direction of circulation is anti-clockwise in the southern hemisphere. The direction is also effected by the shape and position of the coastline.

Ocean currents are of two types—cold and warm. They are cold or warm relative to the temperature conditions obtainable in the surrounding areas. Warm water currents move from low latitudes to high latitudes and cold currents from the polar areas towards the equator.

Uses. Oceans cuttents are useful to man in a number of ways. A study of the rate of insolation received on the earth reveals a zone of

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surplus heat in the tropics and a deficit zone in the high latitudes. Ocean currents, like winds, help in the transfer of heat from the surplus to the deficit areas. In this way ocean currents help in the redistribution of heat on the surface of the earth and to a certain extent modify its climate. Currents also influence the temperature, humidity and precipitation of the nearby coastlands. A warm water current, like the North Atlantic Drift, keeps a number of ports of northwestern Europe open during winter. The meeting place of the cold polar and warm tropical currents is marked by the abundance of plankton and other minerals. Such areas, particularly, over shallow banks, provide ideal conditions for a profusion of aquatic life. Here the nutrients both mineral and organic are brought to the surface by the upwelling of water. The abundance of food makes these banks rich fishing grounds of the world. Sea going vessels often follow favourable ocean currents.

Currents of the Atlantic Ocean

The currents of the Atlantic ocean are well defined and afford a good example of the circulation of ocean waters.

The Trade Winds drag the tropical waters in a westerly direction and give rise to two warm water currents—the *North Equatorial Current* and the *South Equatorial Current*. *Counter Equatorial Current* runs between these two currents in the opposite direction.

North Atlantic. The North Equatorial current is deflected northwards by the northern coast of South America. It is reinforced by the waters of South Equatorial Current which is partly diverted to the north by the coasl of Brazil.

Gulf Stream issues from the Gulf of Florida and is reinforced by the rest of North Equatorial Current. It flows along the North American coast as far as Grand Banks off Newfoundland. It is only 50 m. deep and 50 km. wide. It has a speed of five to eight km an hour. The Gulf Stream is diverted by the south westerlies across the Atlantic Ocean as the *North Atlantic Drift*. In the eastern part of the Atlantic it divides into two branches. The main section of the Drift reaches Great Britain and goes as far as Scandinavian coast. This warm water current keeps number of ports, in this region open in winter.

The small branch of the North Atlantic Drift turns south off the coast of Spain. It flows along the North African coast as the cold

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canary current. The comparative coolness of the water is because of the up-welling of cold water. The canary current completes the clockwise circulation of the Atlantic Ocean.

A cold current sweeps down the Arctic region through the Davis Strait and flows past Labrador as far south as Newfoundland. It is called *Labrador Current*. The cold dense water of this current sinks below the warm waters of the Gulf Stream. The meeting place of these two currents is marked by the formation of fog. The shallow waters of the Grand Banks constitute rich fishing grounds of the world.

South Atlantic

A major portion of the South Equatorial Current is deflected along South America. Here it flows as warm *Brazil Current*. It is deflected by the north westerlies across the ocean as *South Atlantic Current*. Near the Cape of Good Hope a branch of the South Atlantic Current flows northwards along the African Coast as the cold *Benguela Current*. In this region, also, the up-welling of cold polar water takes place. With this current the anti-clockwise circulation of the South Atlantic is complete. The cold *Falkland Current* moves northwards along the coast of Patagonia and sinks as soon as it meets the warm waters of the Brazil Current.

Significance of Oceans to Man

Oceans are a major source of water vapour, which, in atmosphere, cause a great variety of weather phenomena linked with condensation ann precipitation. The distribution of rainfall over the land masses is directly related to the location of an area in relation to sea. Coastal regions, as a rule, receive more precipitation in comparison to continental interiors.

Oceans have a moderating influence on the temperature conditions of coastal areas. The high specific heat of water is responsible for it. The coastal areas have an *equable* or *maritime* climate which is character rised by a low range of temperature—diurnal, seasonal or annual. Differential heating and cooling of land and water also cause land and sea breezes in coastal regions. The weather in the coastal areas is humid as against the dry conditions of continental interiors. Contrary to these conditions, areas far away from the sea have a *continental* type of climate which has for its attributes a great range of temperature, small rainfall and low humidity.

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Oceans act as highways of trade and commerce. Bulk goods like foodgrains, metallic ores, mineral fuels and manufactured articles are being easily, safely and cheaply transported by ocean going ships. Some of the oil tankers, of huge tonnage, carry large quantities of crude or refined petroleum from one part of the world to the other. Oceans have ceased to be barriers to communication. They have assumed a new role of carriers of overseas trade—an indispensable factor of modern civilisation. Blessed are those countries which have a long coastline and a number of open harbours in it. The constraints on the overseas trade, and economic development, of the land-locked countries are quite evident.

Oceans have been harvested by man for ages for his food. Fish constitute an important resource of the sea and fishing is an important economic activity. It is becoming an essential source of minerals and energy. Off-shore drilling is being carried out at a number of places in the world to tap the petroleum reserves present in the continental shelf or the shallow sea bed. Off shore structures in the North Sea and at Bombay High are of great importance.

ATMOSPHERE

The gaseous realm of the earth, the *atmosphere*, with its peculiar composition, is another distinguishing feature of our planet. Atmosphere has been instrumental in the origin, evolution and maintenance of life on this planet. What would have been our earth without its present atmosphere can best be visualised from the conditions obtainable on the moon.

The atmosphere extends to a height of 1,600 km. above the earth. It is the lower 400 km. which have been found to be of great significance to the earth. The density of air decreases with altitude. It is because of this feature of air that 50% of its total mass is below 5·4 km., 75% below 11·2 km, and 90% within 32 km. Most of the water vapour in air is present within the first 3 km.

The atmosphere is as much a part of the earth as the lithosphere and hydrosphere are. We the human beings and other, living cretures live at the bottom of the ocean of air. The atmosphere also rotates alongwith the lithosphere. The earth has been holding its atmosphere on account of its gravitational attraction.

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Composition.

Air is a mixture of gases. The most important gases present in it are nitrogen, oxygen, argon and carbon dioxide. Below is given the percentage composition, by volume of air.

Nitrogen	78·0%
Oxygen	20·9%
Argon	00·93%
Carbon Dioxide	00·03%

The other gases, present in small traces, in air are helium, hydrogen, neon, xenon, krypton, nitrous oxide, methane, ozone and radon. Air also contains variable quantities of water vapour and dust particles.

Oxygen sustains life and supports combustion. Chemically it is an active gas and combines with other elements to form oxides. Ozone is an allotropic form of oxygen. It is a strong oxidising agent but only negligible amounts of this gas are present in lower atmosphere. Nitrogen is an inactive gas. Its function in atmosphere is to dilute the action of oxygen. It helps to regulate combustion. Carbon dioxide is a product of burning and breathing. It is consumed by plants. Carbon dioxide absorbs part of the outgoing terrestrial radiation.

Water vapours are added constantly, to the atmosphere, as a result of evaporation and transpiration. But the amount of water vapour in the atmosphere is never constant. It varies with place and time. Water vapour are closely associated with weather and climate. A remarkable quality of the water vapour is the ability to change from gaseous to liquid and to solid state. It takes the form of crystals of ice or droplets of water. These three forms of water reflect, absorb or scatter insolation and earth radiation.

Most of the dust particles, in the atmosphere, are so minute that they are invisible to naked eye. Their amount also varies from place to place. Dust particles are added to atmosphere from varied sources. These are smoke, salt from ocean spray, pollen grains, soil particles, volcanic ash and meteoritic dust. Dust particles are present in vast amounts in industrial areas and dry regions. These serve as nuclei for the droplets of water and help in precipitation. They also scatter, reflect and absorb solar radiation. The blue colour of the sky, the occasional red colour of the sun sets is due to the selective scattering of the visible solar spectrum by the dust particles and gas molecules present in the atmosphere.

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The composition of the atmosphere remains constant upto an altitude of 80—100 km. after which the amounts of water vapour, dust particles and carbon dioxide decrease and that of ozone increases.

Layers of the Atmosphere.

This is also called structure and zonation of the atmosphere. The atmosphere, in its vertical extent, it divides into four well defined zones—the troposphere, the stratosphere, the ionosphere and the exosphere.

The *troposphere* literally means a sphere of change or turbulence. It is a turbulent dusty zone that contains much water vapour and clouds. With it are associated storms and winds. It is the lowermost layer of the atmosphere and extends to a height of 18 km. at the equator and 8 km. at the poles. This layer is marked by thermal convection. The more the thermal convection the greater is the height of troposphere. This explains the difference in the height of this layer over the equator and the pole. Similarly, over a particular latitude, troposphere is higher in summer than in winter. The fall of temperature with increase of altitude is fairly uniform in this layer. The temperature falls at the rate of 6° C per thousand metres of ascent. It is called normal lapse rate. Weather phenomena are, by and large, restricted to the troposphere. This layer is of considerable importance to a meteorologist. He makes daily probes into the weather conditions existing in its upper parts with the help of *radiosondes* and *rawinsondes*.

The next layer above troposphere is the stratosphere. There exists a plane of separation between the two layers. It is called *tropopause*. Modern jet-planes fly above the tropopause because of the smooth passage of the air craft in this zone. There are no clouds, no storms and no air holes in this region.

The *stratosphere* or the layered sphere extends to an altitude of 80 km from the earth's surface. In the lower part of this layer temperature does not decrease with altitude but remains fairly constant. There is very little water vapour or dust particles present in this zone. The clouds too are absent. The air movements are almost horizontal. In the upper part of this layer there is abundance of ozone. This ozone acts as a protection against ultra-violet radiation and allows only

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desirable amounts to reach the surface of the earth. Most of the meteors that enter earth's atmosphere burn and disintegrate in this layer.

The *ionosphere* extends upto 400 km above the surface of the earth. This layer contains electrically charged particles called *ions*. The radio-waves are reflected back towards the earth by these particles. This layer is instrumental in making radio communication possible.

Above the ionosphere lies the *exosphere* which extends to a height of 1050 km. Beyond it lies space.

Significance To Man.

The surface of the moon is exposed to the constant bombardment of a rain of meteors. This is because of the absence of the moon's atmosphere. It is a well known fact that air, like other fluids, offers resistance to the objects passing through it. A meteor soon after its entry into our atmosphere is subjected to lot of friction which results in the production of immense heat. The meteor burns and disintegrates before it reaches the surface of the earth. Our atmosphere acts as a protective shield against this bombardment from space.

The atmosphere acts as a canopy and checks the entry of entire insolation during the day. At the same time it prevents the loss of entire heat at night. In this way unusual rise of temperature during the day and an extraordinary fall of temperature at night is averted. But for this canopy our earth, like lhe moon, would have been extremely hot during the day and extremely cold at night. The atmosphere maintains the temperature within reasonable limits congenial for the existence of life and for the presence of matter in all the three states. Our atmosphere acts as a filter for the entry of harmful cosmic rays.

No life on earth could be possible without atmosphere. In this regard the role of oxygen and carbon dioxide in animal and plant life, respectively, is well known. It is a repository of water vapour which in turn give rise to different forms of condensation and precipitation. The life giving and life sustaining fresh water is thus distributed on the surface of the earth in the form of rain and snow. The weather phenomena, the fantastic cloud forms, their varied hues and colours, the glorious sunsets and sunrises, the faint glows at the dawn and the dusk are all because of our atmosphere.

In this jet age, it serves as a medium for fast and comfortable means of transport, by virtue of which the globe today, has, so to say, shrunk.

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RESOURCES

The bio-physical environment of man is filled with goods on which he depends for the satisfaction of his wants and needs. He has been exploiting those elements of nature which are potentially useful to him. These gifts of nature are termed as resources. A *resource* is something that is beneficial to man and that leads, ultimately, to his welfare. One of the attributes of a resource is that it should be functional. The solar radiation, the land, the air and the water, each has a certain function to perform and particular needs of man to satisfy. Therefore these are resources. They are used as such. But there are other things which cannot be used in the form in which they exist in nature. They serve some purpose only when they are put to use by man. A resource is to be created out of them. Coal, once, was simply a black rock. It was found to burn and produce heat. It came to be used as a household fuel. At one stage coal was found to be the most suitable fuel for use in steam engines. From a little-cared-for household fuel man found a better use for coal. Coal revolutionised transport and brought about industrial revolution. Coal, therefore, had no resource value unless man bestowed it a function. In this connection Zimmerman has rightly remarked", Resources are not, they become."

With increasing knowledge and multiplying wants, man is adding new resources to his existing list. Mineral fuels, today, include petroleum and natural gas in additlon to coal. Moreover, through researches, he is finding new and improved uses for the same element. By doing so he is increasing the functional capacity of the existing resources. Coal is put to greater variety of uses today than it was fifty years back. Not only is coal, today, an important industrial fuel but also a very significant raw material for a host of chemical industries. The other side of the story is equally interesting. A number of things have lost their

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resource value by his carelessness and misuse. A lake which was once teeming with aquatic life and was a resource has now become a cesspool, the most despised feature of the landscape. So resources by their nature are dynamic and not static.

Classification

Several classifications of resources are available and each is based on some significant characteristics of a resource. Two of these shall be presented here :

(A) Natural resources are classified into the following three categories—*Organic*, *inorganic* both *Organic and inorganic*. Organic resources are derived from the living world, both plants and animals, like forests, natural pastures, wild life and fish. Inorganic resources, on the contrary, are obtained from or belong to the non-living world like air, water, metallic ores, chemical raw materials and mineral fuels. In soil we have soil air, water and minerals (nutrients) comprising the non-living part and humus the living part. Soil, therefore, is both an organic and inorganic resource.

(B) The second attempt for the classification of resources is based on their lasting qualities or permanency. Based on this property, there are three types of resources—*inexhaustible*, *renewable* and *non-renewable*.

It is an inexhaustible resource when it continues to be available despite whatever amount of it has been consumed by man. Examples are solar energy, air, water and sand.

(*ii*) Renewable resources are those that are exhaustible but can be replenished or restocked for further use by man. Forests if managed with wisdom and care can be tapped for a regular supply of major and minor produce. Even if cut thoughtlessly they can be revived and regenerated although with some effort. Same is the case with natural pastures, wild-life, fish and soils. All these resources can be renewed.

(*iii*) A mine, containing a metallic ore, is worked for some time. The ore is mined for the extraction of the metal. A stage comes when, with the removal of last traces of the ore, the mine gets exhausted of its useful contents. It has to be abandoned for it has been completely of the ore. Such resources as get exhausted and cannot be replenished or renewed are called non-renewable resources. There is a limited quantity of such materials available. Non-renewable resources include mineral fuels like coal, petroleum, natural gas ; metallic ores as the

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Ores of iron, copper, lead, zinc, aluminium, nickel etc. and non-metallic substances like mica, asbestos, gypsum, etc.

Conservation

Natural resources like petroleum, coal, metallic ores, soils, forests, wild-life, grazing lands and water must be used with care and in a planned manner so that they are available for use by the greatest number of people today as well as tomorrow. This calls for protection and wise use of our resources or their conservation.

There is a genuine need for conservation of our resources. The resources are limited but human population and the demand for their use is ever increasing. Further not everything available on the surface of the earth is usable. The entire land area of the earth is not fit for man's use. Most of it is mountainous, marshy, desert and ice-covered. Only a small part of the land area, mostly in plains and low hills, is fit for cultivation. Human welfare lies in conserving every acre of available land area. What is true of land area applies equally to our hydrosphere. Oceans account for 97% of the area of hydrosphere, but the water is saline and unfit for use by man to meet the demands of drinking water, irrigation and for industrial use. We are left with only 3% of the total area of hydrosphere, which exists on the land surface in the form of fresh water resources. This small amount of water available to us is to be used with caution and care. Both these examples lend support to the assertion that whatever is usable on the surface of the earth needs to be conserved.

Several guiding principles have to be borne in mind regarding conservation. As most of the natural resources are limited in extent only that part of a particular resource is to be utilised by man as is necessary. At the same time whatever amount of a resource has been taken it must be used without any wastage. This principle applies equally to all types of resources forests or minerals, soil or water. Waste is to be avoided at every step during exploitation, processing and consumption.

A resource needs to be restored or replinished, to the extent possible, as and when it gets diminished. This is all the more true of renewable resources. Clearing of a forest should be immediately followed by afforestation. Exhaustion of soil must be followed by a careful treatment with fertilisers and manures. In case of exhaustible or non-

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renewable resources we must strive for substitutes or alternatives or their reuse. Plastics are, these days, fast replacing timber and metals. Synthetic products are being substituted for natural substances. Scrap metal is collected and reused. Secondary tin is being recovered even in U.S.A. A vigorous search is on, all over the world, for an alternative fuel to replace petroleum. The known reserves of petroleum, at the present rate of consumption, are expected to last for half a century. Scientists are at work to devise new processes for the extraction of metals from low grade ores. It should be our endeavour to see that this lovely earth with all its bounties and endownments continues to be available to coming generations of mankind.

LAND RESOURCES

Significance of land has already been presented in the section on lithosphere. Man uses land for a number of diverse economic activities as agriculture, grazing, lumbering, transport, mining, industries and for human settlements. The use to which land is put at a particular time varies from region to region and it varies from time to time in one particular region. The land use is determined by a number of factors grouped under (a) physical, (b) socio-economic and (c) cultural.

Of the *physical* factors the most manifest is *terrain*. Man has by and large, avoided mountains and high plateaus for his habitat. His first preference is for the lowlands. *slope* is second important factor. Steep slopes are unsuitable for use. He has cut gentle slopes and formed terraced fields to raise his crops. Steep slopes and hilly terrain is avoided while laying railway lines and for road construction. Cultivation, grazing and forests are possible where land has a *soil* cover. The *underlying rocks* determine the quality of the soil. The porosity of these rocks influence the presence of sub-soil water which can be tapped for irrigation. Underlying rocks also determine the presence of mineral ores and fuels. *Drainage* also effects land use. Well drained lowlands are productive agricultural areas. If the land is not well drained it assumes the form of a marsh. Last, but not least, is the factor of location. How far and to what extent is the region accessible ? How close to urban or industrial settlement is it located ? A network of roads and railways account for its accessibility. Nearness to a settlement makes it suitable for raising such produce and products as are in great demand. A remote area is opened up for change and development as soon as a road or a railway link is built through it. Its land use undergoes a remarkable change.

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Land use is also dependent on the socio-economic condition and cultural development of the region. There is a marked contrast between the land use of a primitive tribe and an advanced society. Tradition also plays a vital role in land use. The underlying principle in land utilisation should he to make optimum use of land in order to get maximum returns.

India. The total land area of India is 3·28 million sq. km. It is the seventh largest country in the world. The face of our motherland is characterised by the presence of plains and plateaus, hills and mountains, in the right proportion. The distribution of area under major landforms is given below.

Indian—Area under Major Landforms.

(*i*) Mountains and Hills 29%
(*ii*) Plateaus 28%
(*iii*) Plains 43%

India is favourably placed with regard to area under lowlands and uplands. The total area suitable for human use, on the basis of its terrain, is 62%

How the land is used in India for different purposes is revealed in the following :

Land Utilisation in India (1976)

(*i*) Forests 21·1%
(*ii*) Pastures 4·2%
(*iii*) Fallow Land 7·0%
(*iv*) Net Area Sown 45·8%
(*v*) Uncultivated Land 6·9%
(*vi*) Not Available for Cultivation (including built-up area) 15·0%

The overall picture of land under cultivation is satisfactory. Only the forest area is less than the desired goal of 33%.

MINERAL FUELS.

Man used wood as a fuel for centuries. He found a black rock which, though not as easy to ignite as wood, produced large amounts of heat on burning. It was coal. At a later stage he found a dirty looking oil oozing from the ground which could be burnt in an oil lamp to give light. It was petroleum. While drilling for petroleum an inflammable gas gushed out. It was natural gas. Coal, petroleum and natural gas constitute mineral fuels. They are also called fossil fuels.

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Coal. Coal served as an important fuel for a long period of time. On account of its immense utility it used to be called black diamond. Domestic fuel apart it was used as an industrial fuel of running factory machines, in transport for running locomotives and propelling ships and for the generation of electricity. In fact, it played a key role in the industrial progress of the advanced countries of the world. In spite of the superiority of petroleum as a fuel, coal production all over the world is still on the increase. Coal, besides being an industrial fuel, is a valuable industrial raw material too.

Formation. Coal is burried sunshine of earlier eras. How ? Millions of years ago, during carboniferous period, dense forests comprising trees, mosses. ferns and rushes grew in swamps. The luxuriant growth of this swamp vegetation was possible because of the solar energy received during that period. When these huge plants died they fell into swamps and formed a brown tangled mass called peat. Fresh plants grew on the debris of the earlier vegetation, which also died and decayed. The process continued for thousands of years. The area sank and was covered by a thick deposit of rock, mud, sand and water. The thick mass of peat was subjected to heat and pressure and was gradually transformed into coal. The folding of the earth's crust subjected the coal to intense heat and pressure. This resulted in the formation of superior varieties like anthracite and bitumenous coal. Lignite or brown coal is an inferior variety of coal which crumbles to powder on storing. Coal is an allotropic form of carbon. It is an amorphous variety. It is a sedimentary rock. In it are found fossils of ferns.

The ten leading coal producing countries of the world are U.S.A., U.S.S.R., Great Britain, West Germany, Poland, China, France, India and Union of South Africa.

Coal Resources of India.

Coal fields in India are widely distributed in the Indian Plateau, in the valleys of the Damodar, the Mahanadi, the Wardha and the Godawari. Out of these Damodar Valley has the largest coal reserves and is a leader in coal production. Most of the coal is obtained from the coal fields of Jharia, Bokaro, Giridh, Karanpura in Bihar, Raniganj in West Bengal, Korba, Singrauli, Umaria, Sohagpur, Raigarh in Madhya Pradesh, Deogarh, Talchur and Chanda in Orissa. Kottagudam, Singreni, Tandur and Yellandlapad in Andhra Pradesh.

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Coal fields of Jharia and Raniganj produce good quality coking coal. Large deposits of lignite are found in Neyveli in Tamil Nadu. The total coal production in India during 1984-85 was 131 million tonnes. The large consumers of coal in India are thermal power stations, iron and steel industry, cement factories and railways.

Petroleum.

The oil crisis, that gripped the world in the mid-seventies of this century, had brought the wheels of modern civilisation almost to a crunching halt. Those who were mauled most were the advanced countries of the world. Petroleum has acted as a catalyst for advancement. From the pore spaces of the sedimentary rocks, in which it is found, it has seeped into the pore spaces of our economic fibre, thereby lending strength to it. Any set back to petroleum industry is bound to recoil on man's economic welfare and no person, whatever part of the globe he occupies, can escape its disastrous aftermath.

Petroleum as a, convenient to handle, liquid fuel and as a basic raw material for chemical industry has helped man to introduce spectacular changes in his habitat. It has broken the isolation of far off and remote places and brought them into contact with the modern world through motor transport and aeroplanes. It provides man with heat and light. It is running his machines. Petroleum products are a wartime necessity but they are also an essential requirement in times of peace. Petroleum right from its exploration followed by drilling, extraction, transportation of the crude, refining, distribution of refined products and as a raw material for chemical products has given rise to multitude of industries. It has rightly become the industrial giant of 20th century. Some of the major industries are involved in the manufacture of oil rigs, off-shore platforms, ocean going oil tankers, automobiles, air craft, locomotives and ships. The chemical industries based on petroleum produce a wide range of petro-chemicals.

Formation. Petroleum, like coal, is the stored or trapped solar energy of bygone ages. It is of organic origin and believed to be formed as a result of the decomposition of plant and animal organisms. Petroleum occurs in the tiny pore spaces of sedimentary rocks especially those developed in shallow marine environments. The most favourable rocks for petroleum seepage are sands, sandstones and even lime stones. These constitute reservoir rocks. These are capped by shales or other sedimentary rocks which seal the reservoir rocks and prevent the

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escape of oil and gas. Such a combination forms a petroleum trap. An anticline is an ideal formation for the accumulations of petroleum. Here the sequence of strata, from top to bottom, is gas, petroleum and water.

Petroleum Resources

World. The distribution of estimated petroleum and natural gas reserves of the world on 1.1. 1980 are given below.

Continent	Crude Oil %	Natural gas %
1. Americas	14·0	16·5
2. Africa	8·9	8·2
3. Middle East	56·4	28·8
4. Europe	3·6	5·2
5. Asia & Pacific	3·1	5·0
(*India*)	0·5	0·4
6. Communist World	14·0	36 3

[*Source* : *ONGC, 1981*]

It is evident that more than half of the estimated resources of crude oil are found in the Middle East countries of Sandi Arabia (25 5%), Kuwait (10%), Iran (9·1), Iraq (4·9%), others (5·3 %). The continents of North America and South America and the communist World have equal reserves. Africa stands at number three, followed by Europe and Asia. India's share in the world reserves is bare 0·5%.

The production of petroleum also presents an interesting study. The total percentage production of first ten countries is given in the following table.

Crude Oil Production—1979 [%]

1. U.S.S.R—18·0
2. Saudi Arabia—15·7
3. U.S.A.—14·7
4. Iraq—5·4
5. Iran—4·5
6. Kuwait—4·0
7. Venezuela—3·8
8. Nigeria—3·5
9. China—3·3
10. Libya—3·1

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In crude production India (0·4%) stands nowhere in comparison to giants in oil production like U.S.S.R, Saudi Arabia and U.S.A.

India. The crude production in India in 1950-51 was just two lakh tonnes. Since the inception of I Five Year Plan, sufficient attention was paid to the exploration of oil. In this connection O.N.G.C. was set-up in 1956, in public sector. The other agency working for this purpose is Oil India Limited. Commendable work was done by these agencies for finding new potential oil structures.

Petroleum production and petroleum imports is given below.

Year	INDIA Petroleum Production 000 tonnes	Petroleum Imports crore rupees
1. 1960	4·51	81·6
2. 1970	68·09	183·4
3. 1977	128·41	2492·5

The chief areas of oil production in India are Assam, Gujrat and Bombay high.

The earliest oil field in Assam was at Digboi. The new oil fields are at Nahorkatiya and Moran.

The first oil fields in Gujrat were discovered near Gulf of Cambay in 1958 and at Ankleshwar near Baroda in 1961. The later finds are at Nawagam (South of Ahmedabad) Kalol (north of Ahmedabad) Sanand and Kadi. The Gujrat oil fields contributed about 50% of the total oil production of the country.

Oil was struck in one of the off-shore structures in the Gulf of Cambay about 120 km north-west of Bombay. It is known as Bombay High. An off-shore drilling platform, *Sagar Samrat*, is used for tapping the oil field. The crude is brought by a 203 km long under-sea pipeline to the mainland terminal at Uran. From here another pipe line, 27 km long, carries the oil to Trombay. The commercial production of oil at Bombay High Commenced in May 1978. Oil has also been discovered in Bassein off-shore structure, about 80 km from Bombay.

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FORESTS

Man has been burning wood, from the very earliest times, to keep himself warm. From the branches and leaves of trees he built shelters. Gathering was the first useful activity of man. Trees offered him fruit and nuts to satiate his hunger. Wheel, the first invention of man, was conceived out of a log of wood and so was the first cart constructed with it. He made a multitude of implements out of wood. A tree has always served man as a friend, but man has always been an enemy of the forest. He has cleared forests to make land available for agriculture and industries. He has spared those areas for forests where the slopes were steep or soils too poor for agriculture. The forest areas of the world dwindled and the process of deforestation continues unabated despite the protests and pleadings of the environmentalists.

In the absence of vegetation cover the rain water flows down the slopes unchecked and causes immense soil erosion. The uncontrolled surface run off causes floods in the lower reaches of a river basin. The sediment carried by these flooded streams chokes the water channels and destroys rich agricultural land. Forests control surface run-off and prevent soil erosion, conserve water in the soil and keep the steady supplies of water flowing into rills and ground water reserves. Forest conservation is closely related to soil conservation and water conservation. Forest cover acts as a wind break and prevents soil erosion by wind in arid regions. Forests yield useful products like timer and fuel wood. Wood pulp is used in the manufacture of paper and synthetic fibres. Plywood and veneer are also manufactured from wood. Timber and fuel wood constitute the major forest products. These are obtained by logging and lumbering. The important lumbering trees are deodar, spruce, pine, fir and poplar. The minor produce is collected from the forests. These include latex, resins, gums, wild-nuts, tanning materials, medicinal plants, bidi-leaves etc. Forests serve as the habitat for wildlife. It offers facilities for recreation. Forests lend charm and gaiety to the landscape. Many hill stations owe their scenic splendour, among other things, to forests. Forests influence local climate and increase rainfall. Forestry, lumbering and gathering are important economic activities. A number of industries depend on forests for their raw materials. These are called forest-based industries.

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Forest Resources of India

In India only 22·7% of the total land area is under forests. Forests in India are divided into two major groups—the Himalayan forests and the Extra Himalayan forests or the forests of Indian plains and plateaus. In the former the distribution of forest species is determined by altitude while in the latter it is dependent up on rainfall.

Himalayan Forests

In the damp low valleys of the *eastern* Himalayas, upto an altitude of 900 m, the common trees are sal, shisham, toon and khair. The sub-tropical vegetation, above 900 m, consists of Khasi pine. The monsoon temperature forests are found between 1830 m to 2750 m. The common trees are oak, laurels, chestnut, birch, maple and magnolia. Conifers like deodar, silver fir and sprue are found above 2750 m. Beyond 3650 m lies the zone of alpine vegetation upto an altitude of 4875 m.

The rainfall received in the *western* Himalayas is less in comparison to the eastern Himalayas. In the tropical zone, upto 900 m, the usual trees are acacia, shishun, sal and simal. Chir pine dominates the sub-tropical zone between 900 m to 1500 m. It is tapped for resin and timber. Bhabar grass grows in the foothills region and is used for the manufacture of paper. The sub-tropical, monsoon temperate and other zones in the western Himalayas occur 300 m lower than the eastern Himalayas. Conifers include deodar, silver, fir, blue pine and spruce. The broad-leaved varieties are oak maple, walnut and poplars. Alpine zone ends at 4570 m.

Extra-Himalayan Forests

(*i*) **Moist Tropical Forests.** These are found in areas with rainfall over 300 mm and resemble typical rainforest. These forests cover the rainier slopes of the Western Ghats and Assam. Bamboos form the important undergrowth.

(*ii*) **Tropical Deciduous Forests.** These are also called Monsoon Forests and are found in regions with rainfall between 1020 mm to 2030 mm. These cover most of the area between the Western Ghats, the Thar Desert and the Himalayas. The trees shed their leaves for a brief period. The important trees are teak and sal. Teak abounds in the western parts and sal in the eastern. Other common species are shisham, hurra, mahua and khair.

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(*iii*) **Tropical Thorn Forest.** This type of forest in found in areas, with a rainfall of less than 760 mm, in the northwest of the country and in the leeward side of the Western Ghats. It consists of open stunted trees and xerophytic bushes. The common tree is acacia.

(*iv*) **Tidal Forests.** These forests are found on those portions of deltas that face the sea. The most important tree is mangrove. In Bengal Sundri trees are common. Canes and palms also grow in these forests.

These important commercial forests are those of conifers, (3·2%), sal (14·5%) and teak (7%).

Conservation

Here over aim should not be confined to preserving whatever forests are left but to resort to afforestation so as to achieve the national objective of increasing the forest cover to 33% of the total land area.

Conservation involves the selective felling of trees and to avoid cutting of young trees or seed trees. Entry of the grazing animals particularly into young forests should be prohibited. Insecticides be sprayed on the diseased trees or trees attacked by insects. Forest fires are to be avoided.

Forests should be well managed. Exploitation of forests should be carried out on scientific lines so that there is minimum wastage. The timber should be treated with chemicals to prevent its decay during use.

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